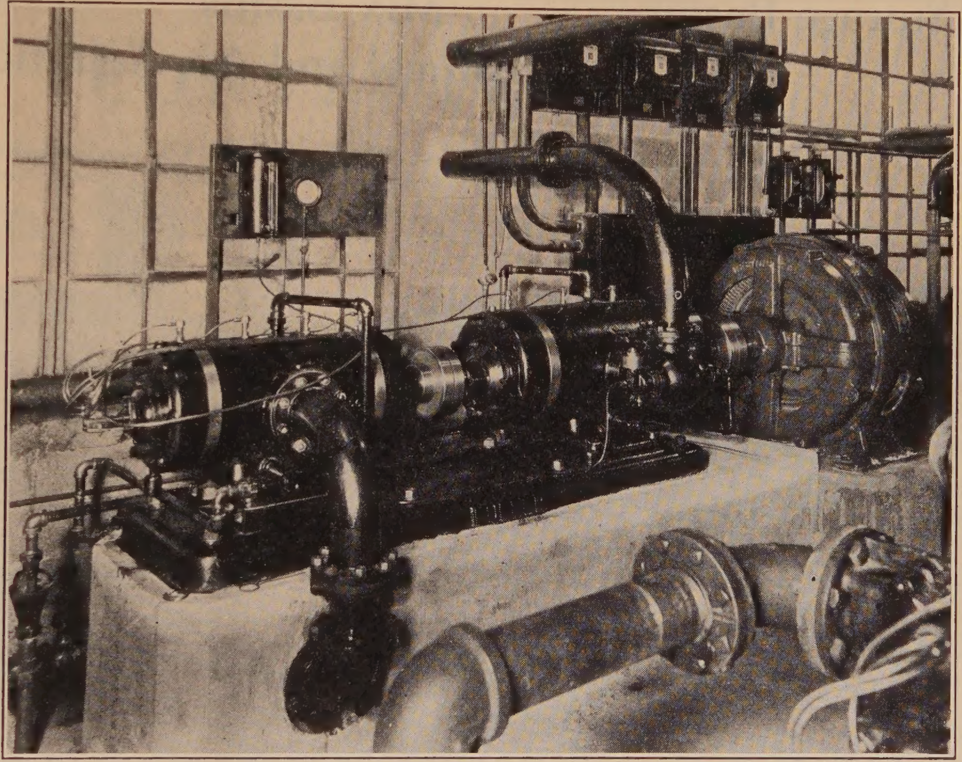
MILL SECTION of

Concrete

ANOTHER LOGICAL APPLICATION OF CONTINUOUS ROTARY MOTION–

Fuller Rotary Air Compressors



This compact, two-stage compressor—one of two installed in a cement plant—has an actual free air delivery of 750 c.f.m. at 100 pounds gauge pressure

THE compressor illustrated has three times the capacity, yet it occupies less space than the belt-driven, reciprocating, single-stage compressor which it replaced—two-stage compression efficiency in one-third the space of the usual single-stage machine. Many of the obvious mechanical advantages responsible for the development and use of the steam turbine and the centrifugal pump are present and have influenced the design of this compressor.

Other advantages peculiar to this rotary compressor are direct line coupling of stages and driving motor, with drive at common motor and internal combustion engine speeds; a continuous flow of air, free from pulsations; the elimination of valves and reciprocating motions; few working parts, all totally enclosed; and the absence of vibration.

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Fuller Rotary Gate Valves—for pulverized materials.

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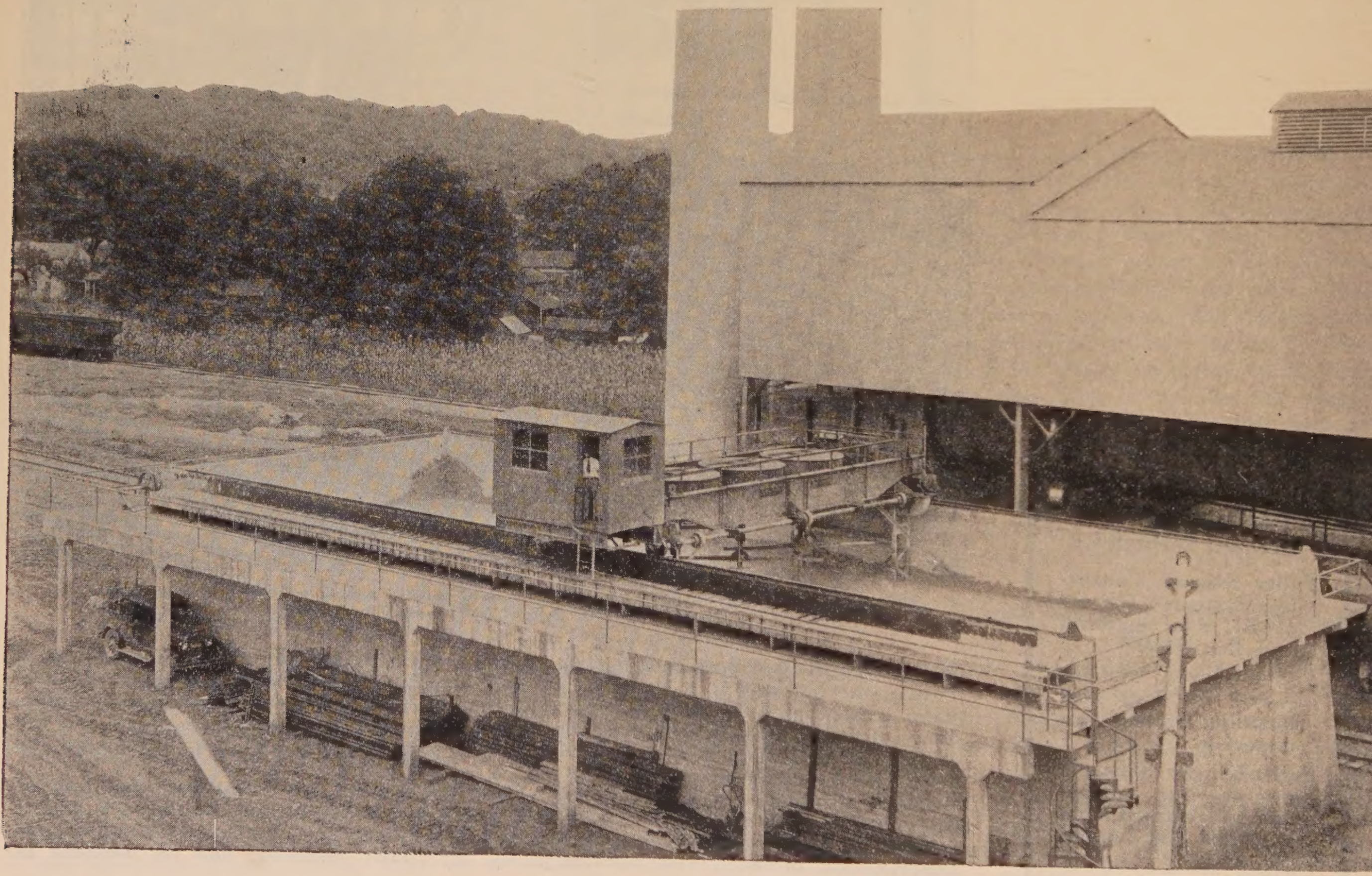

F. L. SMIDTH & CO.

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MILL SECTION of
Concrete

The Cement Mill Edition of Concrete is edited exclusively for those interested in the manufacture of portland cement. Its pages are devoted to discussions of plant design, management, operation, production efficiency, chemical research and control, quarry operation, progress and news of the industry.

The Cement Mill Edition also contains all the material published in the corresponding Regular Edition and so provides news of the uses and merchandising of the materials whose manufacture is discussed in the Mill Edition. The Regular Section furnishes mill operating officials and mill executives valuable points of contact with the users of the materials they produce.

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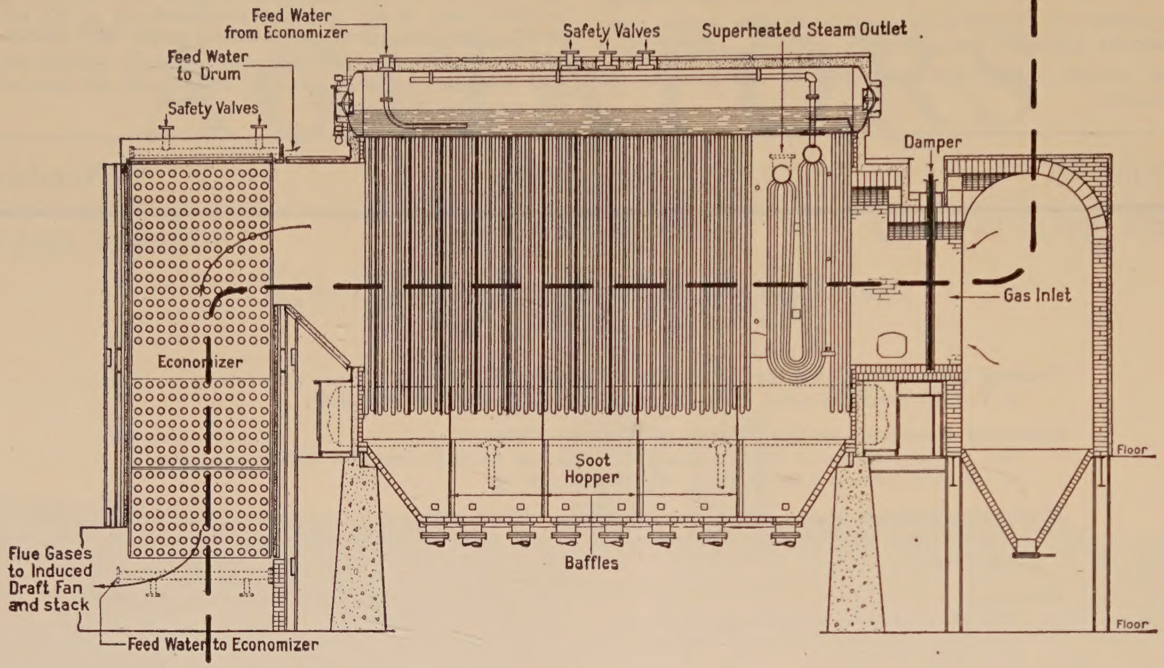
Low Draft Loss



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G-120

MILL SECTION of
Concrete

Vol. 38 Chicago, April, 1931 No. 4

Finding Undeveloped Sources of Fuel for Cement Plants

Seven Additional Low Grade Fuels—Limiting Values Given for Fixed Carbon, Volatile Matter, Ash Content and Moisture—Methods of Treatment

By E. T. ELLIS, F.J.I.
Ecclesall, Sheffield, England

The scope of this series was sufficiently well defined in the first article[1] for nothing further to be required in the way of introductory matter. This article takes up the use of further low grade carbonaceous materials as fuel for cement factories. We shall find that there are a great many interesting and useful ones.
—The Author.

THE seven additional low grade fuels here described, if manipulated in the manner set forth, may be utilized as the means of reducing fuel costs.

Bank Small

In many colliery districts a waste material known as bank small may be bought quite readily. Innumerable varieties of this exist, according to the character of the coal mined, and while some forms are entirely unsuitable for employment as fuel in cement factories, there are many types which prove cheap and effective.

The best samples of bank small should show on analysis a fixed carbon content of about 65 per cent. The total content of volatile matter should be roughly a fifth of this. A large quantity of ash is frequently detected by analysis, but no cement concern should buy samples of bank small showing more than 20 per cent of ash, though sometimes those containing as much as 30 per cent will be offered at apparently tempting prices. The moisture content is very small as a rule, and should never exceed 1.5 per cent, a fuel of the above composition then having a calorific value of 11,700 B.t.u.

The modus operandi does not in this instance consist of air drying, on account of the small quantity of moisture present in most samples of bank small. It will be desirable, however, to pass the low grade fuel along an endless band arrangement, so that stone lumps can be raked out by youths armed with suitable tools. By this means it is often possible to reduce the total ash content to 15 per cent or thereabouts. Following this separation of stone and shale on the band, the bank small should at once be mixed with other small coal of good class, or coke breeze, ordinarily used in the cement factory. The best proportion is an equal volume of each, and when the combination of the two has been finely ground, firing without further treatment can be carried out.

Colliery Breeze

In colliery districts a material going under the general name of colliery breeze is frequently offered. The term unfortunately is a remarkably wide one, and comprises mixtures which are exceedingly rubbishy in character, and no use at all for employment as fuel for cement factories. On the other hand, there are colliery breezes which have more than 60 per cent of fixed carbon present. All samples with a lower fixed carbon content than this should be declined.

An analysis of a suitable type of colliery breeze for employment as fuel for cement factories is before me as I write. This shows a fixed carbon content of 61 per cent, or 1 per cent more than the amount above stated, while the volatile matter content is no less than 10 per cent. This last is also subject to very great variation, according to the actual character of the coal mined. Ten per cent should, however, be the minimum for successful use as fuel in cement factories, but 20 per cent is not objectionable, though it is practically impossible to get such a high figure.

---

[1] Cement Mill Section of CONCRETE, February, 1931, pages 91-94.

The ash content is the worst feature about colliery breeze, even in those which are considered usable. In most instances it will be impossible to get breeze that shows less than 26 per cent of incombustible mineral matter, which remains as ash after use. There are many types which yield far more than this. Cement firms should, however, decline any which contain more than 26 per cent of ash, and should also avoid those which show the presence of more than 3 per cent of moisture. With these constants in mind, it should be possible to obtain a calorific value of 9,700 B.t.u. from colliery breeze.

The modus operandi consists of a short period in an air drying compartment, in which a considerable amount of heat is applied in order to reduce the moisture content to 1 per cent, if possible. Following this the colliery breeze should be passed along an endless band arrangement for examination, but in this instance separation is somewhat difficult, because much of it is finely divided. The object should be to reduce the ash content to about 20 per cent, if possible, by such raking and picking over on the band.

A few of the very best types of colliery breeze can be fired alone as fuel in cement factories, but in most instances it pays to mix them with an equal weight of good class small coal or coke and grind the two together.

Colliery Slack

In many districts there are dumps of low grade fuels known as colliery slacks. In most instances they are good and cheap fuels for cement factories.

No colliery slack should be bought which does not show, on analysis, a fixed carbon content ranging from 42 to 45 per cent. Again, good results can not be obtained with colliery slack if analysis does not show the presence of volatile matter ranging from 25 to 29 per cent. The ash content should be as low as possible, and 12 per cent should be aimed at, although samples containing 17 per cent are usable. Colliery slack which contains more than 17 per cent ash content should be declined. The moisture content, ranging from 12 to 15 per cent, is the worst feature. The calorific value is rather low, rarely exceeding 8,800 B.t.u.

It is essential, in the first instance, to dry these colliery slacks. Air drying is recommended, and a brisk heat gives better results than a moderate one, subject, of course, to avoiding reduction of the volatile matter content. The material is best passed along a heated band in thin layers and these bands should be arranged so that the material can be shaken up automatically. Otherwise, the workmen have to stand in the hot chambers to rake the slack over.

Now as regards the ash content, many authorities recommend these slacks being sifted, so that the fine material may be methodically separated from the coarse. There are undoubtedly samples of colliery slack which respond very well to this treatment, but it can not always be said that the fine material is the useless mineral matter, and the coarse material the carbonaceous substance that we want. It is, therefore, a good plan to screen a small sample and analyze it, comparing the data thus obtained with an analysis of the mixed slack.

Better results are nearly always obtained, however, by passing the air dried colliery slack along an endless band arrangement, or a series of such bands, so that it can be raked over for the removal by hand of pieces of stone, bits of shale, or nodules of pyrites. It will be found, if the sorting has been carefully done, that the composition is very much improved. It is possible, through this process, to take 5 per cent of ash out of it quite readily.

Sometimes these colliery slacks are very acid in character, owing to oxidation of iron pyrites having taken place in contact with air and moisture. A test for sulphuric acid should, therefore, be made, by extracting with water, filtering off, and adding barium chloride, a white precipitate indicating sulphuric acid or a soluble sulphate. If considerable acidity is noticeable, a suspension of the slack should be made in water containing soda ash, the slack then being thoroughly washed with ordinary water, and air dried as rapidly as possible.

Sometimes, on the other hand, these colliery slacks contain carbonate of lime in considerable quantities. The presence of this may be inferred if a sample of finely ground slack is treated with dilute hydrochloric acid, and effervescence results. In this instance the slack should be made into a suspension with water containing dilute muriatic acid, well washed with ordinary water immediately afterwards, and rapidly air dried.

The carbon content and volatile matter content of slacks so treated do not suffer at all, but all soluble ashy substances are completely washed out.

The final step consists of mixing the dried slack with 50 per cent of small coal or coke and grinding the two together.

Heap Slack From Soft Coal

A material known as heap slack from soft coal will often be offered. This rarely requires elaborate treatment as outlined above for colliery slack. For that reason it is a better low grade fuel to employ when the price is favorable.

All samples which do not show a fixed carbon content of at least 42.5 per cent should be declined. A smaller quantity than this usually indicates that the slack has been mixed with other rubbish intentionally. The volatile matter content should be comparatively high, and no heap slack should be bought which does not show at least 30 per cent on analysis. A low ash content should be aimed at, 12 per cent being the allowable maximum. Unfortunately a high moisture content is always a characteristic feature, but 15 per cent should be the absolute maximum. Under these conditions the calorific value of heap slack is about 8,800 B.t.u., or about the same as that of the colliery slack already commented upon.

The modus operandi consists of air drying, in order to reduce the moisture content by 5 or 6 per cent, following which the heap slack should be introduced into hotter chambers, in order to get rid of still further moisture. The heat should not be sufficient to set free any volatile gases other than water vapor. A small consignment of the heap slack should then be sifted, and an analysis of this compared with that of the mixed heap slack, because the dusty portion frequently is richer in total or fixed carbon than the coarse. When the results of this analysis are before you, it is possible to decide whether or not to take the next step, which is usually advisable, and consists of introducing the heap slack onto long band sieves and arming the workmen with metallic rubbers fitted with wooden handles to enable them to rub the slack against the perforations of the band, and so let most of the softer material through. The harder stony nuts are retained on the surface of the band, for they are practically useless as fuel. This sifted heap slack is then mixed with from 50 to 60 per cent of small coal or coke and the combination is ground together and fired without further addition in the cement factory.

Pit Heap Waste

Cement firms are certain to be offered a low grade fuel known as pit heap waste. Its fixed carbon content is about 35.5 per cent in good samples. The volatile matter content is, in many instances, about 27.5 per cent. Unfortunately, the ash content is high, even the better samples showing 30 per cent. The moisture content is usually low, and this fact gives pit heap waste a right to consideration. Most samples, when dried in the ordinary way, show only 2 per cent of moisture. The calorific value of the best samples is not less than 9,000 B.t.u. and this minimum should be specified.

In this instance, with only 2 per cent of moisture present, air drying is hardly necessary, but very careful treatment on endless bands is essential if the use of pit heap waste is to be profitable for firing in cement factories. Passage along bands is frequently recommended in order to divide the waste into two classes, namely, coarse and fine. Each should, however, be analyzed, because the fine material frequently contains as much fixed carbon as the coarse.

Assuming, however, that the coarse material shows the best results, the modus operandi consists of passing it along an endless band to remove pieces of stone, shale, clay, pyrites, and so forth, one passage along such a band rarely being sufficient to get rid of all the unwanted material. As soon as the material drops off the second band, however, it should be passed on to grinders, and then mixed with from 30 to 50 per cent of high grade small coal or coke and reground. Firing can then be carried out without further addition.

Tip Waste

Many cement factory men are apt to confuse tip waste with pit heap waste, while some also confuse them with mound waste and heap slack. In most instances tip waste is very much better material so far as the fixed carbon content is concerned, and every effort should be made to get good samples for use as fuel in cement factories.

No sample of tip waste should be bought which does not show, on analysis, the presence of at least 47.5 per cent of fixed carbon, and at least 25 per cent of volatile matter. The ash content is often very high, but 19 per cent must be regarded as being the maximum allowable. The moisture content is often considerable, but 9 per cent should be regarded as the highest allowable figure. Bearing the above data in mind, the calorific value of 9,300 B.t.u. is possible from the better samples of tip waste.

The modus operandi consists of air drying the tip waste in order to get rid of about 5 per cent of moisture, or even more, after which careful treatment on an endless band is necessary in order to eliminate incombustible shale, stone, pyrites, burnt ash from spontaneous combustion during storage, and other similar substances. By this means it is, as a rule, possible to take out 8 or 9 per cent of the ash. When this is done, the tip waste compares favorably with many other materials previously recommended in this series, and to be recommended in future installments, for use as fuel for cement factories. Admixture with from 50 per cent upward of small coal or coke of the quality ordinarily used in cement factories is desirable. The two or three substances are then ground together prior to direct firing.

Unwashed Duff

Cement firms should carefully distinguish unwashed duff from the various duffs met with and offered by colliery companies as fuel for cement factories. Average samples of unwashed duff are not to be despised, because analysis shows that as much as 65.5 per cent of fixed carbon may be present. The volatile matter content is often low, but this varies with the actual character of the coal mined. Taking everything into consideration, the best constant to aim at in regard to the volatile matter content of unwashed duff is 11.5 per cent, though frequently samples containing much less will be offered at apparently tempting prices.

The ash content unfortunately is always high in unwashed duff, but no samples should be considered which show, on analysis, the presence of more than 21 per cent of incombustible mineral matter. The moisture content on the other hand is always low. Instead of being 9 per cent, as in tip waste, it is often as low as 2 per cent, or about the same as in pit heap waste. The calorific value of good samples of unwashed duff is remarkably high, the best for use as fuel in cement factories yielding approximately 11,300 B.t.u.

The modus operandi in this instance does not, as a rule, necessitate air drying, although it may be mentioned en passant that when much light, incombustible matter is mixed with heavy carbonaceous matter it frequently pays to wash the duff at the cement factory, separate some of this, and then air dry it, in order to get rid of moisture adhering thereto, or rather moisture adhering to the carbonaceous portion. Assuming, however, that it is decided not to wash the duff, the most important step consists of sorting it along an endless band to get rid of stony lumps as completely as possible. Any metallic ores found mixed with the unwashed duff should, of course, be taken out. When one or more passages have been made along the endless band, the unwashed duff is ground up, mixed with other small coal, steam coal, or coke, of the quality ordinarily used in the cement factory, then ground again, and fired without any further treatment.

North American Net Profit Equals $5.00 a Share

The North American Cement Corporation for the year ended December 31, 1930, reports a net profit equal to $5.00 a share on the 7 per cent preferred stock against $5.48 a share in 1929.

Tariff Hearing on Cement Schedules Postponed to April 14th

Senate Also Enters Picture with Norris Resolution for Investigation by Federal Trade Commission

The Tariff Commission's contemplated hearing on the question of 1930 tariff schedules on Roman, portland and other hydraulic cements, originally set for March 12, has been postponed to April 14.

In the meantime it is expected that the staff of the commission will continue its investigation, started some time ago, with the apparent purpose of determining production costs in this country and in foreign countries from which cement has been imported. Particular attention is being given to production costs in Belgium. Under the flexible clause of the 1930 Tariff Act, the commission is supposedly examining the fairness of the rate of six cents per hundred pounds.

The investigation ordered by the Senate, generally known as the Norris resolution, is supposed to be an inquiry to determine whether the cement industry is being conducted in violation of anti-trust laws, and whether unfair trade practices exist in the sale of either domestic or foreign cement.

Vanderwerp Testifies at Wisconsin State Cement Plant Hearing

A proposal that the state of Wisconsin establish a cement plant was the subject of a hearing of the state assembly commerce and manufacturers' committee on March 11. The proposal embodies the Rubin bill, calling for the appointment of a committee to learn the feasibility of state-owned and operated cement manufacturing plants.

H. Vanderwerp, head of the Manitowoc Portland Cement Company, was one of those to appear before the committee. He pointed out that a shutdown appeared eminent at his plant, the only one in Wisconsin, since its bins were filled. Mr. Vanderwerp testified also that there are insufficient limestone deposits in the state to permit profitable cement production and that it is necessary for his company to ship in its raw materials. Another ground on which he and P. C. Dawson, secretary of Manitowoc, opposed the Rubin proposal was that it gave the investigating committee power to subpoena witnesses and testimony regarding operation of the plant.

While other assemblymen opposed the plan because a $10,000 appropriation for a survey was asked and because cement manufacture is too technical to be undertaken by the state, Assemblyman Ben Rubin, Milwaukee socialist, defended his plan on the ground that it was in successful operation in South Dakota where less cement is used than in Wisconsin.

Lehigh Reported as Considering Water Transportation

It is reported that the Lehigh Portland Cement Company is considering the use of Illinois River transportation for shipping cement in bulk from its plant at Oglesby, Illinois, situated on the Vermillion River 1½ miles above its confluence with the Illinois River.

The Lehigh owns property all along the Vermillion River from the cement plant to the Illinois River, and about one mile along the latter stream. The cement company is therefore in a position to develop shipping facilities either on the Illinois River or on the Vermillion River. While the latter location would bring the water shipping facilities directly into the cement plant, recent soundings taken in the Vermillion River show it to be much too shallow for barge navigation, and that dredging of the channel would be necessary.

Ideal Sales Revenue Lower; Earnings Maintained

Boettcher, Newton & Company, investment bankers of Denver, Colorado, in an analytical summary, show that the Ideal Cement Company had a smaller total revenue from sales of cement in 1930 than in 1929, yet its earnings are about on an even basis.

Cement sales in 1930 were $8,463,274 against $8,891,823 in 1929, yet net earnings for 1930 were $1,690,516 as compared with $1,680,332 in 1929. Adding miscellaneous earnings and deduction of interest on debentures, net available for common stock dividends and surplus amounted to $1,806,617 in 1930 and $1,808,594 in 1929. Cash and marketable securities at the end of 1930 totaled $4,940,551 against $5,115,843 for 1929. Total current assets increased from $8,105,680 to $9,126,875, while current liabilities showed a smaller increase from $391,649 to $521,580. Total assets were $27,586,537 on December 31, 1930, as compared with $27,180,428 on December 31, 1929.

Poliet and Chausson Increases Dividend

The French cement firm of Poliet and Chausson announces an increase in its dividends for 1930 from 100 to 120 francs per share.

The capacity of the mills at Beaucaire will soon be increased to an annual production of 160,000 tons of cement by the placing in operation of a new kiln which will be completed within the next few weeks.

Lawrence 1930 Dividend Shows Increase of 63 Per Cent

The report of the Lawrence Portland Cement Company for the year ended December 31, 1930, shows a net profit of $763,302 after depreciation, interest, amortization and federal taxes, etc., equivalent to $10.18 a share (par $100) on 75,000 shares of capital stock. This compares with $476,725, or $6.25 a share, in 1929.

T. H. Jaite Passes Away; Pioneer Paper Bag Manufacturer

T. H. Jaite, 72, pioneer paper bag manufacturer, passed away at his home in Jaite, Ohio, on March 12.

Mr. Jaite was widely known among cement mill executives as president of the Jaite Company, manufacturers of Jaite paper bags, and was active in the business up to the time of his death.

Chemical Reactions in the Setting of Cement

Study of Pure Compounds, Tricalcium Aluminate, Tricalcium Silicate and Beta Dicalcium Silicate—Quantitative Measure of Rate and Extent of Hydration

By LINCOLN T. WORK* and FRANKLIN P. LASSETER†

The second of three installments of an original treatise describing the chemical reactions that occur during the setting and hardening of portland cement is here presented.

This installment describes the investigation of the three principal constituents of portland cement, made by the authors at Columbia University. The concluding installment, next month, will describe investigations of some commercial cements. —The Editors.

REACTIONS OF THE PURE COMPOUNDS

Tests were made with the pure compounds, tricalcium aluminate, tricalcium silicate, and beta dicalcium silicate, which are said to be the principal constituents of portland cement. Evidence was sought as to the specific reactions of each as influenced by varying water-cement ratios and time of ageing.

Data on the Compounds

Analyses were made of the pure compounds as received to determine if either contained any free lime. The results are given in Table VII.

TABLE VII—FREE LIME IN PURE COMPOUNDS

Per Cent by Weight in Compounds Dried at 105 Deg. C.

Compound	Per Cent CaO
$3CaO.Al_2O_3$	0.00
$3CaO.SiO_2$	0.00
$2CaO.SiO_2$	0.16

Experiments with Tricalcium Aluminate

In order to find under what conditions the hydrated tricalcium aluminate could be dehydrated without liberation of lime a sample was heated in vacuum. Two grams of the pure compound were first mixed with 50 per cent, by weight, of distilled water and allowed to set for 24 hours. The hydrate was ground so that 100 per cent passed through a No. 100 sieve and it was dried at 105 deg. C. A two-tenth gram sample was weighed into a small pyrex test tube and evacuated to 8 millimeters. Heat was applied in a pot furnace at increasing temperatures until partial dehydration took place. The temperature at the pressure indicated was found to be between 240 and 250 deg. C. It was measured by placing a quartz mercury thermometer in a pyrex test tube beside the tube containing the sample. Several determinations were made. Loss in weight with rise in temperature is given in Table VIII.

TABLE VIII—VACUUM TEST ON TRICALCIUM ALUMINATE

Relation of Temperature to Loss in Water of a 0.2116 Gram Sample of Hydrated $3CaO.Al_2O_3$ at an Absolute Pressure of 8 Millimeters

Temperature in Deg. C.	Time in Hours	Total Loss in Grams
105	1	0.0000
200	1	0.0050
250	1	0.0350
300	1	0.0392
350	1	0.0406
400	1	0.0426

The total loss at 250 deg. C., based on ignited residue, was 20.75 per cent. There was very little further loss by heating to 400 deg. C. The sample tested in this case was not completely hydrated. Thorvaldsen and Grace[3] found that at 300 deg. C., 75 per cent of the total water of hydration of the hexahydrate of tricalcium aluminate was removed at atmospheric pressure, a reaction which these values further substantiate.

After dehydration the free lime was determined. At the same time the lime in the hydrated sample and in the same sample ignited was determined. Results are listed in Table IX.

TABLE IX—FREE LIME ON HEATING TRICALCIUM ALUMINATE I

Per Cent Based on Ignited Residue

Treatment	Temperature in Deg. C.	Per Cent CaO
Ignited	600–650	25.58
Dehydrated under vacuum	250	2.52
Unignited	——	0.00

It would appear that a small amount of hydrolysis took place on dehydration under vacuum. Thorvaldsen found no lime after dehydration at 300 deg. C. There is a possibility that the small quantity of free lime present in the sample dehydrated under vacuum resulted from heating by radiation on the surface layer of the powder.

---

*Assistant professor of chemical engineering, Columbia University, New York.

†Graduate student, Department of Chemical Engineering, Columbia University.

[3] Loc. cit.

The 24-hour, 7-day, 28-day and 3-month data on the series of eight samples of tricalcium aluminate with varying water-cement ratios are listed in Table X. The data are graphically represented in Figure 2.

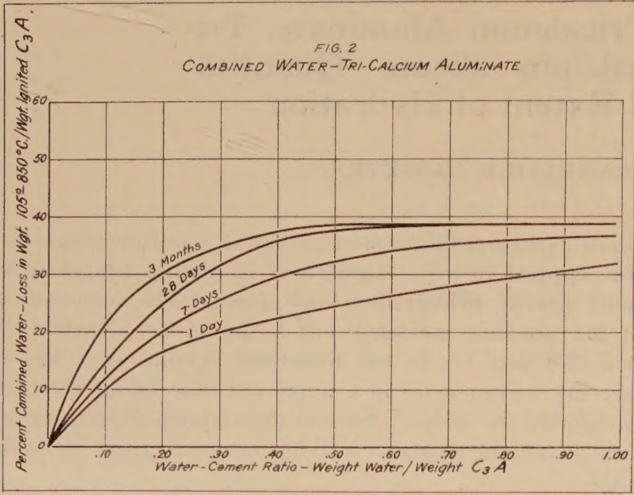


FIG. 2
COMBINED WATER–TRI-CALCIUM ALUMINATE

The reaction of tricalcium aluminate with water to form hydrated compounds was so rapid that little water remained as moisture. With water up to 17 per cent, combination was practically complete in 24 hours. The reaction proceeded toward completion, leaving little residual water with 60 per cent addition after three months' ageing. The value of water of hydration reached a limit of about 38 per cent, which approximates the formula $3CaO.Al_2O_3.6H_2O$ which has been identified by several other workers. When this value is reached hydration may be considered complete.

TABLE X—REACTIONS OF TRICALCIUM ALUMINATE

Percentages Based on Ignited Weight of Tricalcium Aluminate

No.	Per Cent H_2O Added	Per Cent H_2O Detn.	Per Cent H_2O 105 C.	Per Cent H_2O 105–850	Per Cent CaO	Per Cent H_2O as $Ca(OH)_2$	Per Cent H_2O Hydn.
24-hour data							
1	6.00	10.15	0.62	9.53	0.10	0.00	9.53
2	11.00	10.31	0.52	9.79	0.00	0.00	9.79
3	14.00	13.38	0.64	12.74	0.10	0.00	12.74
4	17.00	16.09	0.45	15.64	0.00	0.00	15.64
5	33.33	29.93	8.84	21.09	0.00	0.00	21.09
6	45.00	39.08	15.91	23.17	0.00	0.00	23.17
7	60.00	55.08	29.23	25.85	0.00	0.00	25.85
8	100.00	107.65	75.40	32.25	0.00	0.00	32.25
7-day data							
1	6.00	9.99	0.52	9.47	0.00	0.00	9.47
2	11.00	12.11	0.64	11.47	0.00	0.00	11.47
3	14.00	13.69	0.38	13.31	0.10	0.00	13.31
4	17.00	17.00	0.37	16.63	0.00	0.00	16.63
5	33.33	28.05	0.45	27.60	0.00	0.00	27.60
6	45.00	30.69	0.49	30.20	0.00	0.00	30.20
7	60.00	56.71	20.83	35.88	0.00	0.00	35.88
8	100.00	107.18	71.00	36.18	0.00	0.00	36.18
28-day data							
1	6.00	13.54	0.34	13.20	0.70	0.22	12.98
2	11.00	16.49	0.40	16.09	0.45	0.14	15.95
3	14.00	17.97	0.42	17.55	0.40	0.13	17.42
4	17.00	21.94	0.42	21.52	0.00	0.00	21.52
5	33.33	34.64	0.76	33.88	0.00	0.00	33.88
6	45.00	37.66	0.42	37.24	0.00	0.00	37.24
7	60.00	55.97	16.89	39.08	0.00	0.00	39.08
8	100.00	104.02	65.31	38.71	0.00	0.00	38.71
3-month data							
1	6.00	17.29	0.40	16.89	0.13	0.00	16.89
2	11.00	23.18	0.40	22.78	0.00	0.00	22.78
3	14.00	25.40	0.44	24.96	0.00	0.00	24.96
4	17.00	28.49	0.44	28.05	0.00	0.00	28.05
5	33.33	36.18	0.47	35.71	0.00	0.00	35.71
6	45.00	37.56	0.67	36.89	0.00	0.00	36.89
7	60.00	37.66	0.57	37.09	0.00	0.00	37.09
8	100.00	84.31	47.60	36.71	0.00	0.00	36.71

Most of the lime values were zero, although in a few cases, tenths of a per cent were found. This is in distinct contrast to the values on calcination, but it is in accord with optical data on the hydrated compound.

By a determination of the free lime resulting from ignition of the last four samples of the 3-month tests the data in Table XI were obtained.

TABLE XI—FREE LIME ON HEATING TRICALCIUM ALUMINATE II

Ignition at 650 Deg. C. After Setting for Three Months

No.	Per Cent CaO Based on Ignited Weight
5	26.56
6	27.16
7	28.81
8	28.15

An average of the four values in Table XI gives 27.67 per cent CaO. This is the quantity of lime liberated when the hexahydrate of $3CaO.Al_2O_3$ breaks down on ignition to $5CaO.3Al_2O_3$, a further confirmation of the work discussed earlier in this paper.

The properties of tricalcium aluminate may be briefly summarized as follows: It reacts to form the hexahydrate with water, the extent of that reaction being quite complete within one week. This compound may be partially dehydrated by heating in vacuum to 250 deg. C., with but little development of lime, whereas calcination of the hydrate at 650 deg. C. produces the 5:3 compound and lime as shown by Thorvaldsen.

Experiments with Tricalcium Silicate

In addition to the experiments with tricalcium silicate as outlined in the section on test methods, a systematic series of tests was run to determine the extent of hydration and hydrolysis with varying ages and water ratios.

Le Chatelier[6] came to the conclusion that the fundamental reaction causing hardness in a cement is as follows:

FIG. 3 COMBINED WATER – TRI-CALCIUM SILICATE

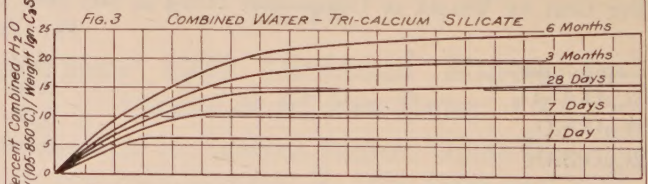
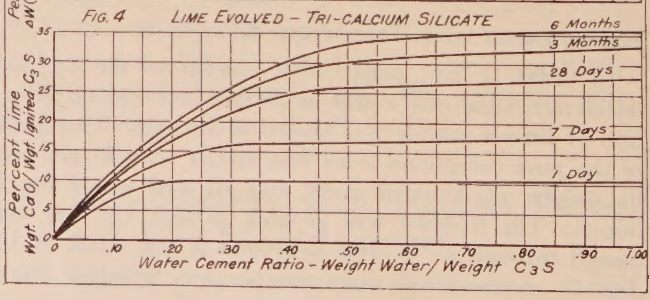


FIG. 4 LIME EVOLVED – TRI-CALCIUM SILICATE



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[6] H. Le Chatelier, *Compt. Rend., 94,* 13 (1882). *J. Soc. Chem. Ind., 1,* 151 (1882). *Trans.* Faraday Soc., *14,* 8 (1919).

$$3CaO.SiO_2 + Aq. \rightarrow CaO.SiO_2.2\tfrac{1}{2}H_2O + 2Ca(OH)_2$$

Klein and Phillips[7] believed that beginning hardness was due in part to hydration of tricalcium silicate and the increase in hardness from 1 to 7 days was due practically entirely to continued hydration of this compound. Bogue and Lerch[8] concluded that the $3CaO.SiO_2$ hydrolizes to $CaO.SiO_2.nH_2O$ at equilibrium.

The 24-hour, 7-day, 28-day, 3-month and 6-month data on the tricalcium silicate are listed in Table XII. The results are graphically represented in Figures 3 and 4.

TABLE XII—REACTIONS OF TRICALCIUM SILICATE

Percentages Based on Ignited Weight of Tricalcium Silicate

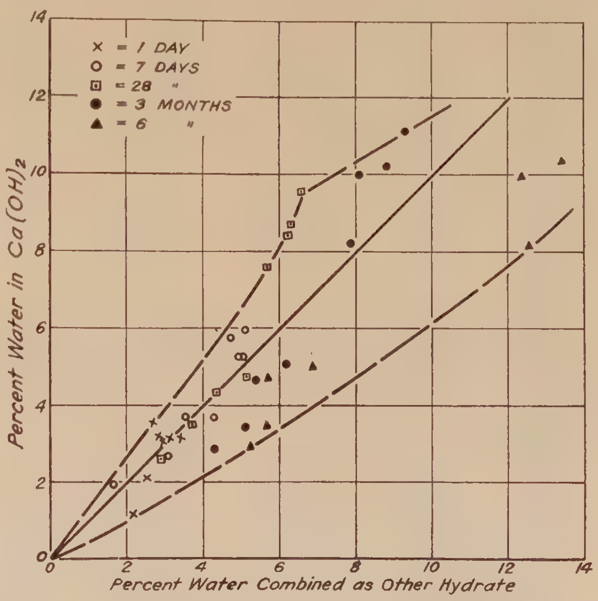
No.	Per Cent H_2O Added	Per Cent H_2O Detn.	Per Cent H_2O 105 C.	Per Cent H_2O 105–850	Per Cent CaO	Per Cent H_2O as $Ca(OH)_2$	Per Cent H_2O Hydn.
24-hour data							
1	6.00	5.11	1.84	3.27	3.30	1.06	2.21
2	11.00	8.31	3.64	4.67	6.51	2.09	2.58
3	13.00	10.70	5.01	5.69	8.65	2.78	2.91
4	16.00	12.25	5.61	6.64	9.90	3.16	3.48
5	33.33	30.77	24.76	6.01	9.60	3.08	2.93
6	45.00	43.19	37.10	6.09	9.71	3.12	2.97
7	60.00	57.48	51.28	6.20	9.61	3.08	3.12
8	100.00	88.31	82.08	6.23	10.98	3.52	2.71
7-day data							
1	6.00	5.71	2.12	3.59	6.02	1.93	1.66
2	11.00	9.15	3.35	5.80	8.36	2.68	3.12
3	13.00	11.76	4.57	7.19	11.28	3.62	3.57
4	16.00	13.60	5.60	8.00	11.43	3.67	4.33
5	33.33	20.43	10.14	10.29	16.57	5.31	4.98
6	45.00	44.46	34.21	10.25	16.31	5.24	5.01
7	60.00	56.82	46.41	10.41	17.64	5.65	4.75
8	100.00	82.93	71.88	11.05	18.47	5.93	5.12
28-day data							
1	6.00	7.62	2.07	5.55	8.22	2.64	2.91
2	11.00	10.79	3.50	7.29	10.98	3.52	3.77
3	13.00	13.54	4.73	8.81	13.68	4.39	4.42
4	16.00	15.25	5.36	9.89	14.73	4.73	5.16
5	33.33	25.62	11.34	14.28	23.65	7.59	6.69
6	45.00	29.57	14.86	14.71	26.31	8.45	6.26
7	60.00	51.66	36.67	14.99	27.07	8.69	6.30
8	100.00	80.18	64.06	16.12	29.86	9.59	6.53
3-month data							
1	6.00	9.88	2.72	7.16	8.89	2.85	4.31
2	11.00	12.28	3.78	8.50	10.56	3.39	5.11
3	13.00	15.04	5.04	10.00	14.37	4.61	5.39
4	16.00	16.97	5.73	11.24	15.74	5.05	6.19
5	33.33	29.18	13.07	16.11	25.59	8.21	7.90
6	45.00	35.82	17.66	18.16	31.34	10.06	8.10
7	60.00	38.32	19.29	19.03	32.01	10.28	8.75
8	100.00	77.34	56.93	20.41	34.67	11.13	9.28
6-month data							
1	6.00	10.64	2.47	8.17	9.04	2.90	5.27
2	11.00	13.16	4.01	9.15	10.79	3.46	5.69
3	13.00	15.82	5.44	10.38	14.58	4.68	5.70
4	16.00	17.79	5.83	11.96	15.62	5.01	6.95
5	33.33	31.79	11.06	20.73	25.41	8.16	12.57
6	45.00	37.88	15.52	22.36	31.14	10.00	12.36
7	60.00	42.15	18.35	23.80	32.36	10.38	13.42
8	100.00	54.81	29.38	25.43	34.57	11.10	14.33

Unlike the tricalcium aluminate, the tricalcium silicate did not react so completely that there was no "free water." Even at the lower water-silicate ratios and the shorter times of ageing, the amount of combined water was but little in excess of the water evolved in oven drying. At the higher water-silicate ratios, there was an excess of water which reacted but slowly during the first few months of ageing. Also, unlike tricalcium aluminate, the tricalcium silicate evolved hydrated lime on reaction with water. Columns 5 and 6 of the tables and Figure 4 illustrate the tendency of the hydrated lime to increase with increase in water-cement ratio. The formation of lime took place at a relatively constant rate up to a limit beyond which the rate was not proportional to water-silicate ratio.

Considered in the light of the precision of these values, a comparison of the last two columns reveals an interesting similarity. Particularly for the one- and seven-day tests the distribution of combined water is essentially one mole to form hydrated lime for one mole in the silicate.

FIG. 5

DISTRIBUTION OF COMBINED WATER



This is illustrated in Figure 5, where values in the two columns are plotted against each other. Although the points seem to fall largely irregularly, that is due to the cumulative effect of small errors upon these small values. However, a smooth curve as drawn illustrates a rough relationship. The following is suggested as a type reaction when tricalcium silicate is mixed with water and allowed to set and harden:

FIG. 6

COMBINED WATER-BETA DICALCIUM SILICATE

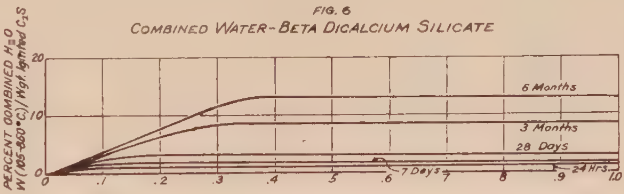
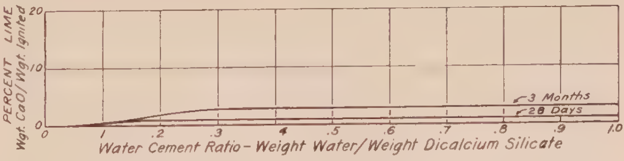


FIG. 7

LIME EVOLVED - DICALCIUM SILICATE



$$3CaO.SiO_2 + 2H_2O \rightarrow 2CaO.H_2O.SiO_2 + Ca(OH)_2$$

This represents the first stage of the probable hydrolysis and there is deviation from it at the higher water-cement ratios and with longer ageing.

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[7] Klein and Phillips, *Bur. Standards Tech. Paper 43* (1914).

[8] Bogue and Lerch, *J. Phys. Chem., 31,* 1627-1646 (1927).

Experiments with Beta-Dicalcium Silicate

Data from the experiments with beta dicalcium silicate for the purpose of determining the effect of varying water-cement ratio and time of ageing on combined water and formation of hydrated lime are listed in Table XIII. These data are graphically represented in Figures 6 and 7.

TABLE XIII—REACTIONS OF BETA-DICALCIUM SILICATE

Percentages Based on Ignited Weight of Beta-Dicalcium Silicate

No.	Per Cent H_2O Added	Per Cent H_2O Detn.	Per Cent H_2O 105 C.	Per Cent H_2O 105–850	Per Cent CaO	Per Cent H_2O as $Ca(OH)_2$	Per Cent H_2O Hydn.
24-hour data							
1	6.00	1.68	0.53	1.15	0.00	0.00	1.15
2	11.00	1.60	0.52	1.08	0.00	0.00	1.08
3	13.00	1.45	0.65	0.80	0.00	0.00	0.80
4	16.00	11.86	10.85	1.01	0.00	0.00	1.01
5	33.33	30.85	29.88	0.97	0.00	0.00	0.97
6	45.00	39.23	38.20	1.03	0.00	0.00	1.03
7	60.00	59.47	58.47	1.00	0.00	0.00	1.00
8	100.00	95.00	93.92	1.08	0.00	0.00	1.08
7-day data							
1	6.00	2.76	1.48	1.28	0.00	0.00	1.28
2	11.00	3.46	2.08	1.38	0.00	0.00	1.38
3	13.00	8.19	6.54	1.65	0.00	0.00	1.65
4	16.00	12.16	10.49	1.67	0.00	0.00	1.67
5	33.33	31.65	29.70	1.95	0.00	0.00	1.95
6	45.00	40.42	38.46	1.96	0.00	0.00	1.96
7	60.00	56.72	55.14	1.58	0.10	0.00	1.58
8	100.00	95.25	93.54	1.71	0.10	0.00	1.71
28-day data							
1	6.00	3.27	1.67	1.60	0.00	0.00	1.60
2	11.00	4.60	2.69	1.91	0.10	0.00	1.91
3	13.00	6.27	3.92	2.35	0.10	0.00	2.35
4	16.00	6.83	4.07	2.76	0.65	0.21	2.55
5	33.33	26.08	22.47	3.61	0.73	0.23	3.38
6	45.00	30.98	27.76	3.22	0.93	0.30	2.92
7	60.00	53.66	51.13	2.53	1.05	0.34	2.19
8	100.00	87.67	85.02	2.65	0.93	0.30	2.35
3-month data							
1	6.00	4.84	2.64	2.20	0.00	0.00	2.20
2	11.00	6.75	3.75	3.00	0.10	0.00	3.00
3	13.00	9.10	4.86	4.24	0.53	0.17	4.07
4	16.00	11.04	5.70	5.34	0.61	0.20	5.14
5	33.33	23.35	13.99	9.36	2.72	0.87	8.49
6	45.00	27.37	18.52	8.85	2.90	0.93	7.92
7	60.00	49.31	41.12	8.19	3.04	0.98	7.21
8	100.00	76.63	68.49	8.14	2.84	0.91	7.23
6-month data							
1	6.00	5.07	2.34	2.73	0.10	0.00	2.73
2	11.00	7.30	3.66	3.64	0.11	0.00	3.64
3	13.00	9.77	4.91	4.86	0.20	0.00	4.86
4	16.00	10.99	5.01	5.98	0.40	0.13	5.85
5	33.33	24.96	11.61	13.35	0.49	0.16	13.19
6	45.00	28.77	14.57	14.20	0.60	0.19	14.01
7	60.00	34.51	22.46	12.05	0.97	0.31	11.74
8	100.00	47.18	34.16	13.02	0.87	0.28	12.74

The absence of any appreciable tendency to react during the first 28 days was the most striking feature of the tests on beta-dicalcium silicate. Only traces of lime in the samples of high water-silicate ratio were found at the end of seven days. Even at the end of 28 days the extent of hydrolysis of the compound was almost negligible. The three-month tests first showed appreciable quantities of lime in the samples of high water-silicate ratio.

The data determined here would indicate that beta-dicalcium silicate is unreactive and probably has little to do with the setting and hardening of cement during the first 28 days. Further, the early action is one of hydration rather than of hydrolysis. These are, however, the characteristics of the pure compound. It must be recognized that the part that dicalcium silicate plays in the hydration of clinker may be more involved.

(To be concluded)

Marketing Policies Find Companies in Three Groups

As a result of attempts during the past four or five months to find marketing methods less subject to abuse than under older methods, the cement manufacturing companies are now adhering to one of three methods.

The first group is still adhering to the Lehigh plan announced on November 10, 1930, and reiterated on February 2, 1931, by a second announcement from the same company. A later announcement carried a warning to dealers that the pressure of competition might necessitate a change. The principal companies in this first group are the Lehigh and the Alpha, together with several of the smaller companies.

The second group consists of the companies who are retaining the old 10-cent dealer differential; that is, the plan followed by practically all companies prior to November 10, 1930. The International is the leading company in this group.

The third group comprises those companies that are now quoting flat prices without dealer differentials. On January 23, the Universal Atlas announced discontinuance of the marketing plan inaugurated on November 13 (similar to the Lehigh plan), and returned to the old sales policy minus the dealer differential, with prices subject only to the usual cash discount of 10 cents for payment within 15 days. The Edison and other companies quickly followed similar plans.

On February 17, the Medusa Portland Cement Co. reiterated its former decision to eliminate all service payments to dealers, and to sell direct, at its lowest prices, to federal, state, county and municipal construction departments, to railroad and hydro-electric companies, to contractors equipped to handle cement without dealer service, and to users in general who have their own cement handling equipment. The Medusa announced also that it would protect only those dealers who are equipped to supply full dealer service, including the carrying of accounts.

It is said that some dealers who shifted their allegiance to members of the second group now find themselves in a difficult competitive situation in markets covered by the direct-selling third group.

A meeting held in Cleveland on February 18, which was said to represent more than half the cement tonnage handled through dealer outlets, indorsed, with several important concessions, the cement sales plan offered by the cement committee of the National Builders' Supply Association. Under this plan the dealers agree to accept the service payment annually instead of quarterly, as they formerly demanded.

On the other hand, the dealers demand a service payment of 10 cents per barrel, instead of the 5-cent payment offered by the Lehigh Portland Cement Co. This remains as the only point of difference between the Cleveland dealer proposals and the plan announced by the Lehigh on November 10.

The Cleveland meeting of February 18 was attended by officials of the various state and district organizations allied with the National Builders' Supply Association, as well as by a number of the lumber associations not so affiliated.

Marquette Extends Barge Operation to Illinois River

Now Has Own Continuous Water Transportation Between Plants at Oglesby and Cape Girardeau and Storage Terminals at St. Louis and Memphis

With the extension of the operation of its four bulk cement barges to the Illinois River at the beginning of March, and the completion of an experimental shipment of bulk cement from its plant at Oglesby, Illinois, to the company's cement storage terminal at St. Louis, Missouri, the Marquette Cement Manufacturing Company has aroused further interest in this mode of transportation.

The barges employed in the initial trip from the Oglesby plant have been in service for two years on the Mississippi River, transporting bulk cement from the company's plant at Cape Girardeau, Missouri. The barges are identical in construction, with a length of 175 feet and a beam of 35 feet. Each barge has a capacity of 5,000 barrels.

The Marquette Cement Manufacturing Company's cement storage terminal on the Mississippi River at St. Louis. The company has a similar terminal at Memphis

The William Dickinson, the steel tug that tows the barges

Round Trips Expected to Occupy Ten Days

The barges, towed two abreast by the steel tug William Dickinson, reached the temporary shipping facilities constructed on C. B. & Q. railway property at Peru, Illinois, on March 2, for the trial shipment. The vessels returned to the Peru docks on March 17, after transporting their cargo to the St. Louis terminal, a distance of about 300 miles, thus occupying fifteen days for the round trip.

Considering the fact that this was the first trip and that the loading equipment was newly installed, and the further fact that operation on the Illinois River prior to March 16 was in daytime only, it is expected that the round trip time will be cut to ten days. The reduced time will be made possible mainly because of the official opening of Illinois River navigation on March 16. With the channel buoyed and lighted the vessels can now be operated 24 hours daily. On the first trip the actual running time was around 48 hours in each direction. The downstream speed, with barges loaded, was about 7 miles per hour. The upstream speed, with the barges empty, averaged 6 miles per hour.

Conditions Favorable to Navigation

At the present time the channel in the Illinois River is guaranteed to have a depth of 8 feet and 2 inches. Conditions are favorable to barge navigation, due to excellent work on the part of government officials.

Transferring Cement from Mill to Barges

The cement is transferred in bulk, in freight cars, from the Oglesby plant to the shipping point, a few miles away. At the shipping point Fuller-Kinyon pumping equipment has been installed in a small shed and in underground pipe conduits, for transferring the cement from the cars to the barges. This transfer equipment is located on C. B. & Q. Railway Co. property.

In the meantime, the cement company has bought a new site for a possible private shipping terminal, on the south side of the Illinois River, at a point 3 miles north of the

Oglesby plant. With this site in its possession, the cement company would be in a position to build its own transfer railway from the plant to the shipping terminal, should future requirements make such a move desirable or necessary.

Comparing Shipping Costs

The present freight rate on bulk cement from Oglesby to St. Louis is 13 cents per hundred pounds. Consequently, the freight charge on the equivalent of a full 4-barge cargo of 20,000 barrels amounts to about $9,775, or nearly 49 cents per barrel.

The purpose of the present experiment is, therefore, to determine whether, after taking account of operating costs, interest on investment, depreciation of equipment, taxes, insurance and all other overhead charges, cement can be shipped more economically in the company's own barges than by rail. The fleet crew consists of twelve men.

It is said that the original cost of the four barges was $65,000 each, and that the steel tug William Dickinson represents an investment of around $140,000, bringing the total cost of the fleet and tug to about $400,000. To this investment must be added the cost of the cement company's shipping terminal development on the Illinois River near the Oglesby plant.

Storage Terminals at St. Louis and Memphis

One of the illustrations shows the cement company's storage terminal on the Mississippi River at St. Louis, located at Malt and Haven Streets, and served by the Missouri Pacific Ry. A similar terminal has been built at Memphis.

With a second cement plant at Cape Girardeau, Missouri, on the Mississippi River, midway between St. Louis and Memphis, the Marquette has continuous water transportation between plants and storage terminals, giving the company a favorable position in the St. Louis and lower Mississippi Valley market.

Ideal's Portland Plant Installs Natural Gas Fuel

Used in Kilns, Driers and Boilers — Coal-Using Equipment to Remain

By D. A. MORSE

The Portland, Colorado, plant of the Ideal Cement Company early in March completed alterations and installations for the use of natural gas as a fuel. The gas has been contracted for with the Interstate Gas Company, and is piped from their resources in Texas.

The gas is taken from a central point in the yard and distributed to the different places of consumption, including the kilns, driers, and boilers.

The only alterations necessary in the kiln room were the removal of the coal burners, these being replaced by gas burners made at the plant. An 8-in. line supplies the gas to the kilns.

Gas for the driers is supplied by 2-in. pipes. Burners purchased from the Denver Fire Clay Company are installed here, while an automatic regulator limits the flow of gas to the two driers. No alterations were necessary in this department.

Heine boilers, which have been in use for a period of twenty-five to thirty years, were altered again. When these boilers were first installed, it was necessary to feed the coal by hand. Later they were altered for stokers and were fed by that means until recently. The stokers were removed and the openings closed. Lientz gas burners are employed with the boilers. A 6-in. line from the central point to the boilers will furnish the gas.

A 1-in. line is used as a supply for the blacksmith shop, while a ¾-in. line pipes the gas to the laboratory for testing purposes.

The equipment for the use of pulverized coal will be kept ready for any change that might be desired in the future.

Scrap Michigan State Cement Plant, Bill Proposes

Michigan's state cement plant, a storm center since 1923, when it was taken over by the state, on March 4 took its place among the issues before the legislature when Rep. Dexter Look of Lowell introduced a measure to close the plant.

The bill stipulates that the plant shall discontinue operations at once and in lieu of a buyer for the property, the state shall eventually scrap the equipment. The state prison would be prevented from operating the plant.

The Chelsea cement mill was taken over by the state in 1923 and later was purchased at a cost of $625,000. With improvements and additions, the state's capital outlay represents around $766,000. No appropriation for the plant has ever been made by the legislature and it has operated on money advanced from the general fund and all revenues have been turned in to the fund.

At the present time, it is estimated that the plant owes the general fund $661,630.

Marquette Launches Improvement Program at Cape Girardeau Plant

An improvement program involving its entire Cape Girardeau, Missouri, plant is being undertaken by the Marquette Cement Manufacturing Company. The Burrell Engineering and Construction Company, Chicago, is the contractor.

Work will include complete rehabilitation of the grinding department, clinker grinding department, installation of an improved system for handling and cooling clinker, additions to kilns and boilers, and improvement of power generating units.

Glens Falls Installs 380-Ft. Kiln to Replace Four Short Kilns

New changes being made at the plant of the Glens Falls Portland Cement Co., at Glens Falls, N. Y., include the installation of one new 380-ft. rotary kiln to replace four of the short kilns previously employed. The new kiln is known as the Unax, supplied by F. L. Smidth & Co., of New York.

Lone Star Texas to Make Addition to Plant

An addition costing $83,000 is to be erected by the Lone Star Portland Cement Company, Texas, at its Houston plant.

~ EDITORIAL ~

Will the Experience of Michigan Sink In?

THE people of Michigan have been told some facts about the state-owned cement plant at Chelsea; and officials of privately owned cement plants did some of the telling, through newspapers and other channels.

Most impressive among these facts is the one that discloses a loss to the state of three-quarters of a million dollars since the plant was leased in 1923. As a result of these disclosures, a bill has been introduced in the state legislature which would authorize the sale of this white elephant.

The history of the Chelsea plant is precisely what must be expected from political ventures into business and commerce. Leased in 1923, the plant was bought in 1928.

Then the tide turned and troubles were multiplied. In spite of the use of convict labor, the immunity from taxes and selling expenses, and various other financial advantages, deficits piled up from year to year.

In the face of Michigan's experience, scarcely a week passes without its grist of news about legislative agitation somewhere, in favor of a state cement plant.

A special feature in a financial magazine, headed "Our Amazing Politicians," is well named. The lesson from Michigan may never sink in.

Required—Another Designers' Manual

AN editorial in last month's issue, entitled "Where More Sustained Promotion Is Needed," emphasized the necessity for more intensive and better coordinated cultivation of the market possibilities in concrete-encased steel frame buildings.

Brief mention was made of the economy of this type of building, providing that full recognition can be given to the combined strength of both the concrete and the steel. This point requires amplification.

Except in rare cases American designers of buildings and bridges have always followed the wasteful practice of assuming that in a concrete-encased steel beam or girder the steel carried the entire load and the concrete acted only as fireproofing or protection against weathering. Ordinary common sense must have convinced them that, in reality, there is common action between the concrete and the steel, for neither material can be stressed without the other being stressed also. But no published design formulas were available, and until quite recently no comprehensive field tests were available from which theoretical formulas could be verified.

Now the results of tests conducted by the Western Society of Engineers show that steel beams and girders encased in concrete are more than 40 per cent stronger than the same steel members considered alone. These tests, reported in full in the June (1930) Journal of the Western Society of Engineers, are described on page 34 of the June (1930) issue of "Concrete." The same issue of "Concrete," pages 35-37, contains theoretical formulas for the design of concrete-encased steel beams and girders.

Here, then, is the necessary material for developing the first step in promoting general acceptance of the true structural value of concrete-encased beams and girders—namely, the preparation of a manual or handbook for their design. Other steps will be required, but this should be the first.

Who will finance the preparation and distribution of such a handbook? The cement industry is the logical answer to this question, for this industry is in a position to obtain the greatest benefit from the general acceptance of this type of structural design.

The Price of Progress

"IT is wiser to have the junk heap outside the factory than in it," said a well-known industrial economist during a recent address. He estimated that nearly half the manufacturing equipment in American factories is obsolete.

In the cement industry it has been estimated that 25 per cent of the plants are operating with out-of-date, profit-eating equipment. Other estimates place the percentage much higher.

The owners of these obsolete plants are forgetting that so long as the world continues to breed engineers, industrial chemists, and inventors, just so long will it be unsafe—suicidal, in fact—to assume that the highest development has been reached in cement manufacture.

These technical men are never content with things as they are. They are forever engaged in devising new or improved processes, methods and equipment, of the kind that mean new economies and a better product. Just when some manufacturing improvement has completed the development stage and has become a part of standard practice, a still greater improvement renders the previous one obsolete.

This is the price that is paid for progress, and no one can avoid it. Only those who have the vision and the managing ability to keep up with that progress will survive the next five years. Those who fail or refuse to keep up the pace will soon find that there's a hidden danger in their obsolete equipment, a danger that may be discovered too late.

West German Cement Syndicate Renewed for One Year

Agreements Reached Through Purchase and Exchange of Ownership—Expect Some Small Plants to Be Closed Down

By GRAF A. von KERSSENBROCK
Berlin-Grunewald, Germany

Contrary to newspaper reports stating that the West German Cement Syndicate had been renewed for two years, it has been renewed for one year only, and great difficulties had to be overcome before even that could be accomplished.

Syndicate Demanded 100 Per Cent Membership

As the result of conferences near the end of 1930, the members of the syndicate extended their agreements for a month, or to January 31, 1931, to avoid dissolution at the end of the past year. This extension of one month was made in the hope that the one remaining outside firm would agree to come into the syndicate. Only by having all manufacturers in the western territory within the organization could the syndicate be renewed.

Readjustments in Ownership

The chief difficulty, quite naturally, was that of getting the last of the outside firms into the ring. This was finally achieved, on January 29, when the Atlas Portland Cement Works at Paderborn agreed to enter the syndicate.

The agreement was reached only after certain readjustments were made. First, the Atlas production for 1931 was bought by a Swiss cement firm which, at the same time, bought the Hausen Cement Plant. The latter plant is located in Switzerland, and before this change in ownership it belonged to the Wicking Concern. In turn, the Swiss cement firm turned over to the Wicking Concern a cement plant in Alsace (France). Thus the competition between the Wicking organization and the Swiss cement industry has been settled in the same move.

Agreements with Surrounding Countries

The existing agreements with Belgium and Holland as to the quotation of prices are maintained, and a similar agreement with France will follow. The relations with Switzerland are also settled by the above mentioned exchange of plants, and thus peace has been assured anew within the range of continental cement industries.

May Close Small Plants

It is most probable that many of the smaller plants which are not up to date in their equipment will be closed down or will be operated only in times of extraordinary large demands for cement. The mergers of last year may lead to further combinations within the industry in the course of this year.

Regional Safety Meetings at Washington and St. Louis

Sixty-four persons attended the regional safety meeting held at the Hotel Raleigh, Washington, D. C., on March 10. The morning session, in charge of Chairman W. M. Powell, opened with a brief report presented by A. J. R. Curtis, secretary, Committee on Accident Prevention, Portland Cement Association, on the subject, "Progress of the Accident Prevention Program During 1930." Several short talks on "The One Most Effective New Idea Used by Our Company Last Year to Prevent Accidents" were given by representatives of six plants in the vicinity.

A similar gathering was held at St. Louis, Missouri, on Tuesday, February 24, at the Hotel Coronado.

Prison-Operated State Plant Proposed for Texas

A bill introduced into the Texas house of representatives on March 9 provides for the establishment of a penitentiary plant to manufacture cement and other road building materials. An appropriation item of $500,000 for erection of a manufacturing plant is included in the measure.

The bill would create a penitentiary industry location board. The function would be to select a site for a plant and arrange for its construction. The state highway department would be required to contract with the prison system for manufacture of cement and other materials for highway projects. The measure also provides a manner in which the plant could furnish materials to contractors holding state highway contracts.

The prison system would not be allowed to make more than a 3 per cent net profit on its manufactured products.

Czechoslovakian Cement Sales in 1930 Equal Those of 1929

In spite of depression, the sales of cement in Czecho-Slovakia during 1930 equal the sales during 1929. Cuts in prices are in part responsible for holding the market stable.

The Slovakian cement mills in Bratislava, which are capitalized at 15,000,000 crowns, report net profits for the year at 14,836,000 crowns and have declared dividends of 75 per cent.

Trident Plant Installs Sampling Department Elevator

Speeded by a period of unusually mild weather, the program of winter repairing at the Trident, Montana, plant of the Three Forks Portland Cement Company was rapidly nearing completion in March.

A new elevator has been installed in the sampling department and other changes made for dust elimination.

Dewey Plant Resumes Capacity Operation

The Dewey Portland Cement Company plant at Dewey, Oklahoma, resumed operation on March 3 with a full force of 300 men. Improvements, including general repairs and the construction of several large units for storage facilities, had been completed.

French Cement Firm Declares Dividends

The Societe des Ciments Vicat, Grenoble, France, reports net profits of 2,710,376 francs and will distribute dividends of 10 per cent on Class A shares and 5 per cent on Class B shares.

How Trinity's Quarry Cars Operate Under Remote Control

Track Installation Described — System Divided Into Twenty Insulated Sections, Controlled from Stations at Crusher House and Quarry

By R. F. EMERSON
Industrial Engineering Dept., General Electric Co.
Schenectady, N. Y.

THE Trinity Portland Cement Company, of Dallas, Texas, transports its cement rock from quarry to crusher house in four cars without train crews, by means of a remote control system. Since no one rides on the cars, they appear to start and stop as if possessed of an intelligence of their own.

This scheme of remote control consists of dividing the whole track (Figure 1) into insulated sections which can be energized or de-energized at the will of the dispatcher at his desk (Figure 2). This track consists of two 56-lb. rails with two 40-lb. third rails mounted between them. All four rails are bonded, and are divided into twenty sections as indicated in the lower part of Figure 1.

Cars Loaded by Electric Shovel

The cars are loaded at the quarry by means of an electric shovel. Power is brought to the shovel over a 2300-volt transmission line. This power transmission line also furnishes the power for operating the cars, except that the power for the cars is first transformed to 220 volts by a number of 100 kva. transformers which are distributed at approximately equal distances along the whole track system. This transmission line system and the transformers are shown in the upper part of the layout in Figure 1. A number of control cabinets are also installed along the track containing magnetic switches, which are closed or opened at the will of the operator, and which connect the 220-volt power to the track system. One of these contactor boxes or control cabinets is represented in Figure 1 connecting the 220-volt bus to track section No. 10.

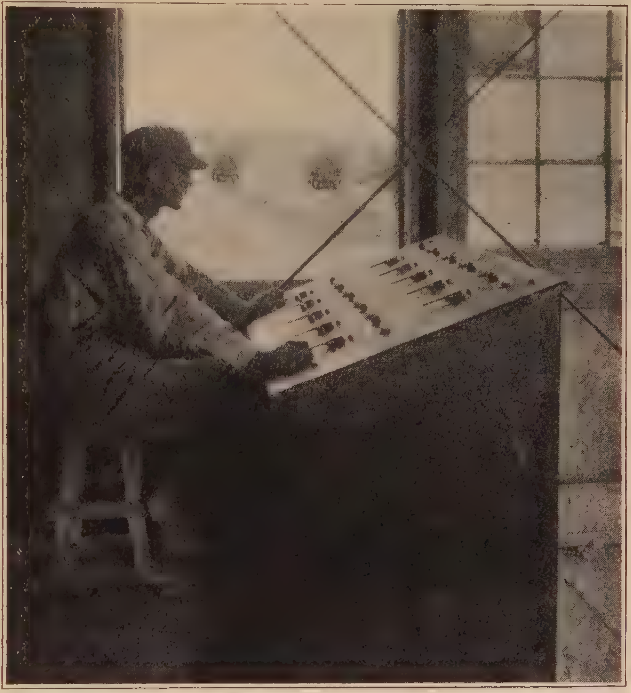


Figure 2. Control desk at crusher house, with dispatcher on duty

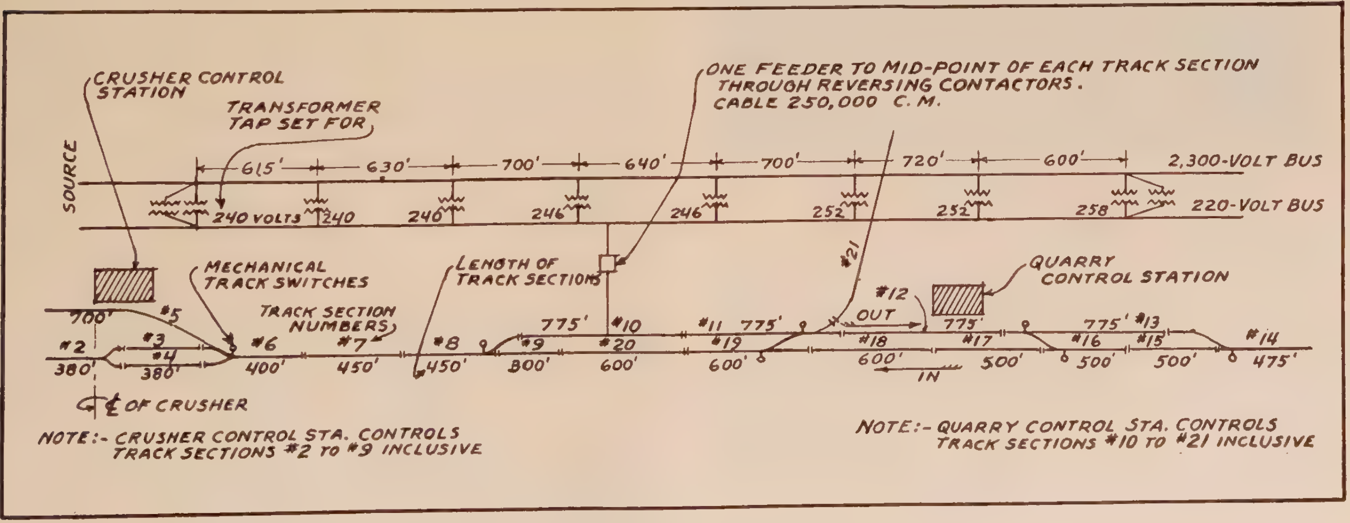


Figure 1. Track layout and electrical connections between quarry and crusher house

Motors and Brakes on Cars

The electrical equipment carried on each car consists of two 50-hp. squirrel-cage induction motors and two solenoid brakes. When power is applied to a track section on which a car is standing, the motors start on full voltage and at the same time the brakes will release. If power is cut off from a track section, or if a car runs onto a dead section of track, the brakes automatically set by spring action, and the car coasts to rest. Motors and brakes constitute the entire electrical equipment on the cars. Due to the fact that the motors start on full voltage, no resistors, accelerating contactors, relays or similar devices are necessary, all of which tends to reduce maintenance. Track grades are 3 per cent and greater, but the chance of runaways is very small due to the characteristic of the induction motor to regenerate power when it is overhauled and hold back the load. This characteristic is inherent in this type of motor. It automatically breaks the load without requiring any attention on the part of the operator or depending on the operation of a cam, switch, relay, or any other mechanical or electrical device. If electric power happens to fail when a car is going down a steep grade, the brakes will set immediately and prevent a runaway.

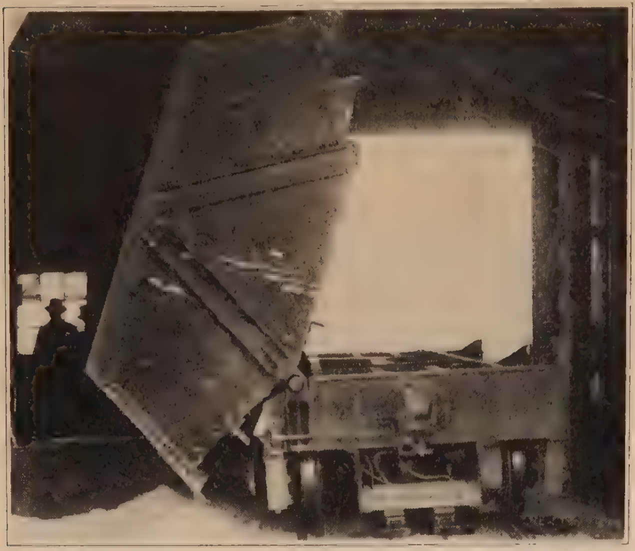


Figure 3. Car in crusher house in fully dumped position

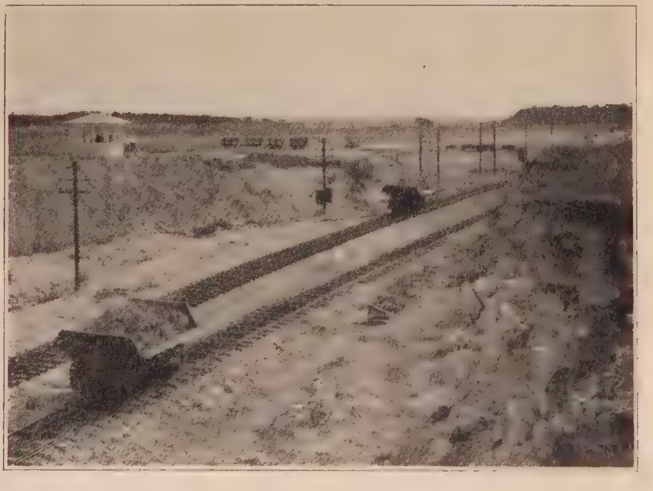


Figure 4. Remote-controlled quarry cars in operation

Regenerative Motors Conserve Power

Another advantage of the regenerative feature of these a.c. motors is the conservation of power. The regenerated power is fed back into the electric power system, so that the power regenerated by a car going down a grade is used to operate other cars on other sections of track. A test for power consumption of a period of several hours shows 0.544 kwh. per ton-mile, with the cars traveling at an average rate of approximately 13 miles per hour.

Shovel Operator Does Own Dispatching

It is perfectly feasible to control all operations of the four cars from a single control desk, but due to the length of the track it was deemed desirable to use two control desks, one at the crusher house (Figure 2) and a duplicate one in a control booth near the quarry. Also, a small control panel was installed in the electric shovel to control the last three sections of track, so that the shovel operator could dispatch his loaded cars as fast as he filled them, and also hold all incoming empties on a dead section of track until he was ready for them.

A Flexible System

This system of bringing cement rock from quarry to crusher is flexible to the extent that more cars can be added without increasing the number of operators and (to a certain extent) without increasing the amount of control equipment and number of transformers.

Where Improvement Is Seen in Cement Shipments

Five States Show Increases for Four Successive Months Over Same Period in 1929-1930

It is interesting to note the states into which portland cement is being shipped in larger quantities than in the corresponding period of last year.

In the four successive months of October, November, December and January, cement shipments into Massachusetts, Missouri, Oregon, South Carolina and Washington amounted to the combined total of 4,308,434 bbl., compared with 3,181,058 bbl. in the corresponding four months of a year before. The 4-month period totals, by states, are as follows:

	Shipments, in Bbl., in 4 Months Ending in Jan.	
	1930	1931
Massachusetts	796,539	885,121
Missouri	1,296,522	1,482,569
Oregon	268,065	303,849
South Carolina	271,867	754,377
Washington	548,065	882,518
Totals	3,181,058	4,308,434

Montana, New Mexico and West Virginia have each received larger shipments in November, December and January than in the corresponding period of 1929-1930. Here the recent totals were 439,094 bbl., compared with 370,398 bbl. a year ago.

Shipments into Kentucky and the District of Columbia were 225,033 bbl. in the two recent months of December and January, compared with 168,746 bbl. in December and January of a year ago.

Quarry Accidents Reduced in East

Cement Companies Given Credit for Excellent Showing —Quarries of Penn-Dixie No. 4, Cowell and Lehigh's Iola Plant Have 5-Year Record Free of Accidents

By **THOMAS J. QUIGLEY**
Chief of the Mines and Quarries, Department of Labor and Industry

PENNSYLVANIA is one of the pioneer states in the quarrying industry.

Long before the birth of concrete roads, bridges, or reinforced concrete buildings, quarrying was a very important industry in supplying the steel mills of Pennsylvania with limestone. Very little attention was given to the quarry industry from a standpoint of safety or accident prevention until April, 1925. The Honorable Gifford Pinchot, governor of Pennsylvania, appointed Richard A. Lansburgh secretary of labor and industry. Shortly after the appointment of Secretary Lansburgh, he decided to make a survey of the quarries in Pennsylvania for the purpose of reducing the fast-mounting accidents in the industry.

In April, 1925, I was appointed to make the survey and make recommendations for the prevention of accidents. I made a survey of the industry, visiting sand pits, limestone, granite, trap rock, cement rock and slate quarries, making a special study of the different hazards found in the different kinds of quarries. The survey completed, we prepared safety regulations to protect the workers in the industry. Tentative regulations were printed and distributed among the workers and operators, public and group meetings were held throughout the state. Every person attending these meetings was given ample opportunity to express his approval or disapproval of the regulations. When they were adopted, they had the approval of practically every important operator in Pennsylvania.

A campaign of education was then started to educate the workers regarding the new regulations. Copies were placed in the hands of all the workers, safety committees were organized at all the quarries, plant meetings were held in the quarries. Speakers explained the regulations and appealed to the individual workers to co-operate with the state and the management for the reduction of accidents. Community meetings were held in churches, high school auditoriums and theaters. Motion pictures depicting safety were shown at the meetings to help spread the safety gospel among the workers. Speakers were furnished for all the meetings to deliver safety talks to the workers, their wives and families. Thanks to the very high grade of men who owned and operated the quarries in Pennsylvania, they co-operated 100 per cent with the State Department of Labor and Industry and spent thousands of dollars for music, entertainment, pictures and printing to put the safety movement over. As proof that our campaign has been a handsome success, I quote you the following accident figures:

The new regulations went into effect January 1, 1926. In 1927, the first year of our operation under the new safety regulations, we had a reduction of 10.2 per cent in accidents as compared with 1926; in 1928 a further reduction of 4 per cent as compared with 1927, and in 1929 a reduction of 10.8 over 1928, or 25 per cent accident reduction in 1929 as compared with 1926.

For three consecutive years, we have shown a reduction each year and for the first eight months of 1930 our accident records show 6 per cent below 1929 or 31 per cent below the figures for 1926. When an industry can show a reduction in accidents for four consecutive years, what owner or operator can advance an argument against the methods used in Pennsylvania to reduce accidents. Personally I feel that the quarry owners in Pennsylvania have made a record to feel proud of.

Perfect Records

One of the outstanding records was made by one of the large quarrying companies in the eastern part of the state. In 1927 this company had 308 lost-time accidents, or one accident each working day, working 26 days each month. In April, 1928, this company started safety work and reduced the number of lost-time accidents to 158 for the year 1928. In 1929, they showed a further reduction of 59 accidents for 12 months, and for the first seven months of 1930 they showed 5 lost-time accidents at all of the eight plants operated by the company, employing about 800 men—an average of less than one accident per month in 1930 as compared with 26 accidents per month in 1927.

Many other quarries in Pennsylvania have made remarkable records: Ormrod Quarry, Lehigh Portland Cement Company, had a perfect record for two years. Ormrod No. 2 Quarry, Lehigh Portland Cement Company, had a perfect record for one year. Hercules Cement Company, Stockerton, had a perfect record for one year. Lone Star Cement Company, Nazareth, had a perfect record for one year. Medusa Portland Cement Company at York had a perfect record for 18 months. Giant Portland Cement Company, Egypt, had a perfect record for one year.

And last but not least, the No. 4 quarry, Pennsylvania-Dixie Cement Company, Nazareth, Pennsylvania, the pride of all quarries in the old Keystone state with the magnificent record of four years and ten months, free of accidents. The last accident in this quarry was October 31, 1925. The record of the Penn-Dixie Cement Company is surpassed only by the Cowell quarry of the Cowell Portland Cement Company at Cowell, California, which had its last accident August 14, 1925, and the quarry at the Iola, Kansas, plant, of the Lehigh Portland Cement Company, which had its last accident September 18, 1925.

These records I have just quoted, prompt me to make a suggestion. Many of the delegates present here today are also members of the National Crushed Stone Association. It has been my one ambition to see the National Crushed Stone Association go into accident prevention on the same basis as the Portland Cement Association. I would like to see the National Crushed Stone Association select a man of the type of A. J. R. Curtis, put him in direct charge of the accident section and go after accidents with a determination that accidents must stop. I am confident that a real live man in charge of the accident prevention section would return handsome rewards to your association.

Abstracted from paper read before the Nineteenth Annual Safety Congress, Pittsburgh, Pa., Sept. 29 to Oct. 3, 1930.

World Production of Portland Cement in 1927

Department of Spanish Government Compiles Cement Production in Eighteen Countries—Some Producing Countries Omitted

The world's production of portland cement, amounting to 375,000,000 barrels in eighteen producing countries in 1927, is tabulated in a publication recently issued by the Ministry of the Interior of the Spanish government. While not all of the countries that produce cement are listed, the production and capacity figures are believed to be around 90 per cent of the total. The production and capacity figures follow:

WORLD PRODUCTION OF PORTLAND CEMENT IN 1927

	Production and Capacity of Portland Cement in 1927	
	Production in Bbl. Production in Metric Tons	Capacity in Bbl. Capacity in Metric Tons
United States	172,000,000	228,000,000
	29,700,000	38,900,000
Germany	44,300,000	69,800,000
	7,560,000	11,900,000
France	31,700,000	42,200,000
	5,400,000	7,200,000
Great Britain	29,600,000	32,900,000
	5,050,000	5,600,000
Belgium	16,600,000	18,500,000
	2,840,000	3,150,000
Japan	15,800,000	20,100,000
	2,700,000	3,420,000
Italy	15,800,000	20,100,000
	2,700,000	3,420,000
Canada	9,500,000	15,800,000
	1,620,000	2,690,000
Russia	9,500,000	16,700,000
	1,620,000	2,850,000
Spain	5,750,000	7,400,000
	980,000	1,260,000
Poland	4,200,000	7,900,000
	720,000	1,350,000
Czecho-Slovakia	4,200,000	5,300,000
	720,000	900,000
Jugo-Slavia	3,700,000	6,450,000
	630,000	1,100,000
Denmark	3,500,000	4,600,000
	600,000	790,000
Austria	2,750,000	5,800,000
	465,000	990,000
Hungary	2,650,000	4,550,000
	450,000	775,000
Switzerland	2,100,000	5,150,000
	360,000	880,000
Rumania	1,750,000	6,150,000
	295,000	1,050,000
Totals in Barrels	375,500,000	517,400,000
Totals in Metric Tons (2,204.6 lb.)	64,410,000	88,225,000

NOTE: Upper figures are in barrels; lower figures in metric tons.

Among the countries and regions not included in the above estimate are Australia, New Zealand, Africa, Mexico, Cuba, South America, India and Scandinavia.

Utica Hydraulic Annual Meeting; Officers Re-elected

The annual meeting of stockholders and directors of the Utica Hydraulic Cement Company was held at Utica, Illinois, on March 16th, following a dinner served in the Illinois Valley Manufacturers' Club, La Salle. Reports tendered by officers at the meeting indicated that the local industry was operating about normally, and that the outlook was bright.

F. C. Dettelbach of La Salle was re-elected president of the company.

Other officers who were re-elected included John A. Conley, of Chicago, vice-president, and S. M. Spillane, Ottawa, secretary-treasurer. The board of directors, with the exception of the addition of Robert Dettelbach, of Valparaiso, Ind., to its membership, is the same. H. P. Howells, of Cleveland, was renamed chairman of the board.

Among the stockholders and directors attending were George Anderson, of Lansing, Mich.; Mr. Howells, Mr. Conley and Robert Dettelbach; C. A. Riemenschneider, of Cleveland; Robert Mehren and D. H. Christianson, of Chicago, and J. D. Dingle, of Ottawa.

Five Firms Awarded Missouri Highway Cement Contracts

The Missouri State Highway Commission on March 10 awarded contracts to the following plants for its 1931 cement requirements of about 1,700,000 barrels: Missouri and Alpha Portland Cement Companies, at St. Louis; the Atlas Portland Cement Company, at Hannibal; the Marquette Portland Cement Company, of Cape Girardeau, and the Ash Grove Portland Cement Company, at Kansas City.

French Cement Firm Increases Output

The Societe des Ciments Francais, Paris, France, has increased the output of its mills from 575,139 tons, in 1928, and 638,259 tons, in 1929, to 668,000 tons, in 1930.

This increase is due to important additions to the equipment of its several mills. During February, 1930, a new kiln of large dimensions was put into service at Guerville and during the entire year of 1930 the mills at Daignac were operated at their full capacity.

Lehigh Pennsylvania Plant Resumes Capacity Operation

The New Castle, Pennsylvania, plant of the Lehigh Portland Cement Company resumed capacity production schedules on March 10. Extensive new machinery and equipment have been installed during the recent slack period.

Roumanians Form Cement Production and Sales Syndicate

Cement producers of Roumania have organized a syndicate which will exercise control over production through allotment quotas as well as sales.

Approximately 40 per cent of the national cement production annually is represented in the agreement, it is estimated.

Super Cement Process Refined to Make Improved Product

Fineness Such That 325-Mesh Sieve Retains Not More Than Five Per Cent—Chemical Composition of Clinker—Comparison Between Super Cement of 1926 and 1931

By E. W. REED-LEWIS
Vice-President and Director of Research, The Super Cement Co., Detroit, Mich.

In view of the well demonstrated interest in special cements, a description of the high points in the refined process for the manufacture of Super Cement is given below. The chemical and physical characteristics of the product are described and a comparison is made with the same special cement of five years ago.

This article is published as a matter of information to the cement industry. Other special cements will be similarly described, with the same purpose in view, as the opportunity is offered.—The Editors.

> "A variety of portland cement was introduced by Mr. J. F. Goddard in 1915 under the name of Super Cement. This cement is manufactured from portland cement clinker by grinding in with it treated gypsum instead of the ordinary gypsum used for regulating the setting time. Super Cement was originally intended to be a waterproof portland cement; that is to say, an ordinary portland cement to which material was added in order to render it waterproof, thus obviating the disadvantage of having to entrust the mixing of the waterproofing compound to possibly careless or ignorant workmen. It was soon found, however, that the cement prepared in this manner not only produced a waterproof mortar, but the latter was also much stronger than ordinary portland cement mortar, thus differing from the usual waterproofing materials. . . . It is too soon to say definitely in what manner this addition of the treated gypsum acts upon the cement, but it certainly is neither a mere water repellent nor a pore filler. The main effect appears to be to bring about a more complete hydration of the cement particles."

THE above quotation, taken from "Limes & Cements," Ernest A. Dancaster, B.Sc. (London), A.I.C., 2nd Edition, published by Crosby Lockwood & Son, London, 1920, requires little or no revising to make it fit the Super Cement of 1931.

Process Refined in Detail Only

The process has been refined in detail only. The purpose is still, primarily, to produce a cement capable of making waterproof concrete without the need for supplementary admixtures. The incidental feature, noted years ago, that Super Cement produced concrete having other desirable qualities in addition to that of being waterproof, has been the subject of continued study, leading to most of the refinements in process since adopted. The main effect still appears to be that a more complete hydration of the cement particles is brought about.

And since the end toward which every detail in the manufacture of hydraulic cements is directed is the production of a material that will hydrate, or combine chemically with water, and by so doing form an effective cementing medium in concrete, the influence of the Super Cement process would seem to be an appropriate one.

Seeking better to understand the reactions that take place in the setting and hardening of cement and the various factors that govern them; seeking to facilitate these reactions and better to control them; seeking, in other words, to bring portland cement clinker to a condition in which its potential cementing properties can be utilized to the best and fullest advantage; refinements in the Super Cement process have been developed from time to time and have in due course been adopted both in Europe and America. It is the purpose of this article briefly to outline the nature of these refinements, what they have accomplished and what manner of concrete will result from the proper use of modern Super Cement.

Chemical Composition of Clinker

In the manufacture of Super Cement, no other clinker is used than portland cement clinker of normal chemical composition. To illustrate what is meant by "normal chemical composition," the tabulation in Table 1 is given.

TABLE 1

Potential Constitution of Typical Modern Cements

(*Calculated from their chemical analyses*)

Cements	Tricalcium Silicate ($3\,CaO.SiO_2$), Per Cent	Dicalcium Silicate ($2\,CaO.SiO_2$), Per Cent	Aluminates and Minor Compounds, Per Cent
Normal American Portlands	44	28	28
American Super Cements	46	25	29
European Super Cements	49	23	28
American H.E.S. Portlands	72	1	27
European H.E.S. Portlands	73	2	25

No radical change has ever been made in the chemical composition of the clinker used in the manufacture of Super Cement. Any minor changes have been in the direction of lowering the tricalcium silicate rather than raising it.

Stimulation of the process of hydration by using clinker of abnormally high tricalcium silicate content has been deliberately avoided for several reasons, chiefly, however, on the premise that cements prepared from such clinkers liberate more lime in the form of calcium hydroxide when they hydrate than do cements prepared from clinker of normal chemical composition.

Evidence that this calcium hydroxide serves a useful purpose in concrete seems notably lacking; rather does there seem to be a widespread opinion, and not altogether an irrational one, that under many conditions of exposure this calcium hydroxide is the least desirable constituent of concrete from the point of view of permanence; a necessary evil perhaps, but one that might well be restricted to a minimum in so far as this is possible.

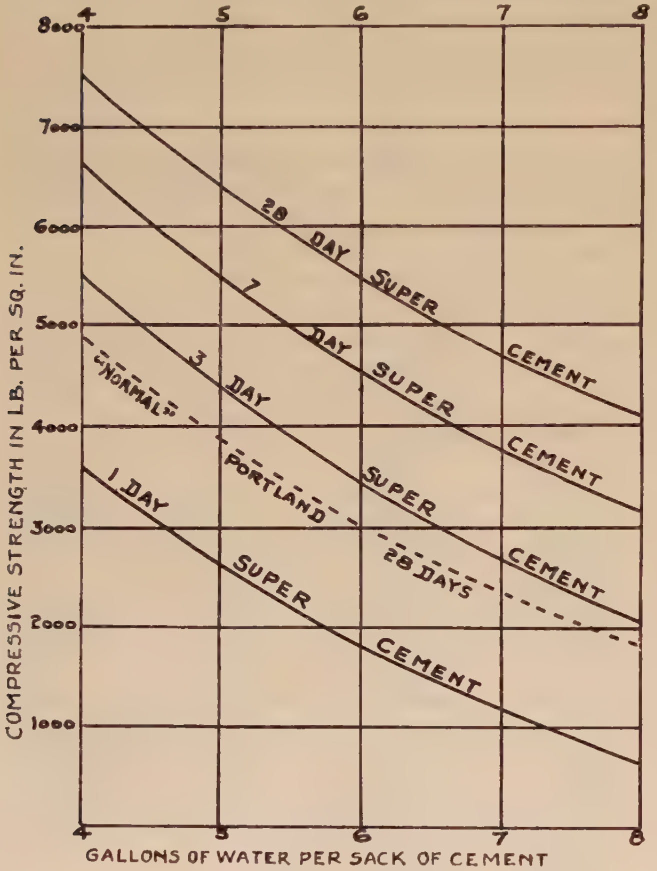


Figure 1. Relation between compressive strength and water-cement ratio at various ages

Additions to Clinker Subsequent to Calcination

In the manufacture of Super Cement, as in the manufacture of normal portland cement, gypsum is added to the clinker during the grinding process in order to regulate the setting time of the cement.

In the case of portland cement, the quantity of gypsum that may be added for this purpose is limited by existing specifications, which arbitrarily stipulate maximum SO_3 values permissible in the finished cement. The stipulated limit in the United States has for some years been 2.0 per cent. It has long been higher in most European countries. Recently the limit in the United States has been raised to 2.5 per cent for cements classed as "high-early-strength portland cements."

European manufacturers of Super Cement have for many years carried their SO_3 at about 2.5 per cent, with distinct advantages to the quality of the cement. The SO_3 of American Super Cements has, until recently, been carried at or below 2.0 per cent. It is now carried at about 2.5 per cent, to the same advantages in quality noted in the case of the European product.

One other ingredient, and one only, is added to the clinker subsequent to calcination in the manufacture of Super Cement. This ingredient is tannin, which is added in combination with a portion of the gypsum. Modifications have been introduced from time to time in the proportions and in the conditions under which the tannin and gypsum are combined. The quality and variety of tannin employed have also been the subject of productive study. Conditions having been brought about which facilitate the action of the tannin, it has been found advantageous to reduce somewhat the quantity used. In the modern Super Cement there is approximately one pound of tannin in three thousand pounds of cement.

It seems appropriate here to note that tannin, as utilized in the Super Cement process, has of itself no cementing or waterproofing properties. It is employed for the apparent catalytic influence it exerts on the hydration processes of the cement and for its further influence on the physical properties of the cementing medium that results from these hydration processes.

Fineness of Super Cement

The purpose of grinding cement clinker is, of course, to make possible a more complete hydration of the cement. Since the effect of tannin in Super Cement is directed chiefly toward the same end, these two factors should obviously be susceptible of synchronization toward an optimum joint influence.

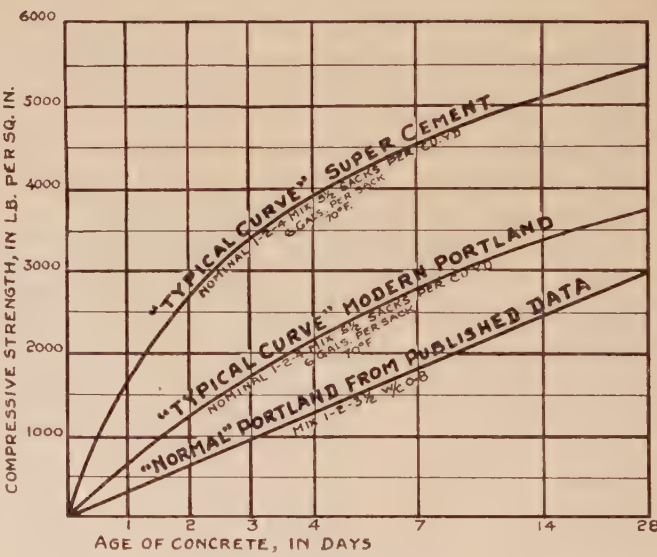


Figure 2. Comparative relations between strength and age

Space will not permit more than brief mention of the studies involved in seeking this optimum. It may be stated, however, that they indicate that cement particles coarser than the No. 325 sieve serve no significant purpose in impermeable concrete. Consequently they are now eliminated as much as possible. Seldom will more than five per cent of this relatively inert material be found in Super Cement.

The grading of particle sizes in the 95 per cent of Super

Cement that is finer than the No. 325 sieve has been found to be of striking importance. In studying this question, pulverized cement clinker was separated by air classification and otherwise into five fractions having mean particle sizes ranging from a nominal diameter of 58 microns for the coarsest fraction, passing the No. 200 sieve but retained on the No. 325, down to a mean particle diameter of less than 5 microns for the finest fraction. These fractions were then recombined in varying proportions with suitable additions of gypsum and varying quantities of the tannin compound. The properties of these "physically synthetic" cements were then carefully studied from every angle. These studies have determined, among other things, the effective fineness to which Super Cement is now commercially ground, the term "effective fineness" being here used to signify a consideration of fineness in relation to the grading of particle sizes, in distinction from the usual consideration of fineness in terms of percentage residue on a No. 200 sieve.

Laboratory Test Data

While perhaps of uncertain practical significance, Table 2 presents the conventional laboratory test data, values being the averages for the product of several American mills in 1926 and in 1931 to illustrate the change that has been developed in Super Cement in that period.

TABLE 2

Comparison Between Super Cement of 1926 and 1931

	Initial	Final	1:3 Standard Sand Mortar Briquettes			
Year	Set	Set	24 hrs.	3 days	7 days	28 days
1926	3:00	6:00	——	235	325	430
1931	2:50	5:30	319	415	488	569

Storage Qualities of Super Cement

The refinements in process having so notably increased the activity of the product, their possible effect on its storage qualities naturally demanded close observation. Repeatedly the modern Super Cement has been sampled from the mill stream as it was ground, packed in single cloth sacks and stored where it would be subject to free circulation of fresh air as in a dealer's warehouse for periods up to three months and longer. During these periods the cement was sampled and tested at intervals of one week. Typical results of such tests in sack storage are shown in Table 3.

TABLE 3

Effects of Warehouse Storage

	1:3 Standard Sand Mortar Briquettes			
	24 hrs.	3 days	7 days	28 days
Tested fresh	322	411	500	606
Tested after 12 weeks' storage	353	461	520	619
Average of 13 tests	322	433	505	594

Super Cement Concrete

The plasticity imparted to concrete by Super Cement has always been a notable feature. Refinements in process have accentuated this. The plastic condition is maintained, moreover, for a very satisfactory period after mixing. For instance, concrete leaving the mixer with a slump of 4 inches will, under normal conditions and without remixing, still have a measurable slump after standing for one-and-a-half to two hours.

This period of plasticity is followed by a period of slow solidification. The concrete begins to develop measurable strength at about nine hours after mixing, and from that point up to an age of 24 hours there is approximately a straight line relation between strength and age.

The strength-age relation for typical Super Cement concretes from 24 hours up to 28 days is illustrated by Figures 1 and 2. Available tests indicate that, with continued access to moisture, concrete strengths at one year, for normal mixes, are about fifty per cent higher than at 28 days.

Determination of Magnesium in Portland Cement

The maximum amount of magnesia (MgO) allowed by Federal specification 1a and the standard specification for portland cement (C9—26) of the American Society for Testing Materials, is 5.00 per cent (plus a tolerance of 0.4 per cent). Since a great deal of cement is purchased under these specifications it follows that many determinations of magnesia are required. At present the phosphate method is standard, and is quite accurate and proper for umpire analyses, but it is rather lengthy.

The precipitation of magnesium by the reagent 8-hydroxyquinoline has been studied at the bureau, and in the January, 1931, number of its *Journal of Research* a method is recommended for determining magnesium by use of this reagent. The recommended procedure is accurate and much more rapid than the standard phosphate method.—From *Technical News Bulletin*, U. S. Bureau of Standards, December, 1930.

Nebraska Completes Improvements and Makes Additions to Equipment

Improvements completed early in March at the Nebraska Cement Company plant at Superior, Nebraska, were the installation of Hummer screens in connection with the No. 622 wet compeb mill and the addition of a large quarry locomotive for use in transporting the raw material from quarry to crusher. A 2-yd. Bucyrus Diesel shovel for the quarry, located 2½ miles from the plant, has also recently been purchased.

Rather than shut down the plant during the winter months, while general repair and improvement work was under way, Superintendent D. C. Coulson put the plant on part capacity, cutting down hours and retaining all employes.

German Cement Sales in 1930 Below Those for 1929

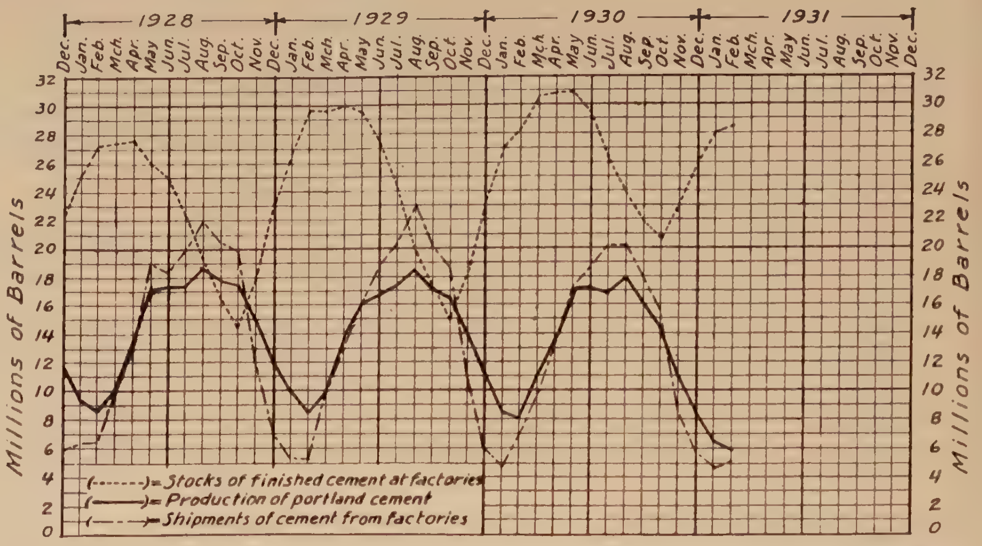
The total sales in 1930 of the German cement industry, as combined in the German cement syndicates, reached only 5,510,000 tons, compared with 7,040,000 tons in 1929. The December sales amounted to 215,000 tons, as compared with 317,000 tons in November, 1930, and 305,000 tons in December, 1929.

Belgian Cement Firm Increases Profits

The annual report of Ciments Portland Artificiels Belges d'Harmignies, Brussels, Belgium, shows net profits of 5,448,074 francs as compared with 5,292,831 francs for 1929. Dividends of 55 francs per share have been declared.

Cement Statistics for February

Bright Spot Is Rise in Shipments Over January — Figures Continue at Low Levels Compared to 1930



Relation of Production to Capacity

(Figures represent per cent)

	The Month	The Twelve Months
February, 1931	29.4	59.7
February, 1930	**41.5**	**65.6**
January, 1931	29.5	60.6
December, 1930	38.2	61.5
November, 1930	51.7	62.6

	1930	1931	Increase or Decrease, %
Production, February	**8,162,000**	5,920,000	—27.5
Shipments, February	**7,012,000**	5,048,000	—28.0
Stocks at end of month	**28,249,000**	24,478,000	8.0

	1930	1931	Increase or Decrease, %
Total production for year	**16,660,000**	12,515,000	—15
Total shipments for year	**11,967,000**	9,740,000	—19
No. of plants reporting	165	165	0.0

Production, Shipments, and Stocks of Finished Portland Cement, by Districts, in February, 1930 and 1931, and Stocks in January, 1931

District	Production—February 1930	Production—February 1931	Shipments—February 1930	Shipments—February 1931	Stocks at end of month 1930	Stocks at end of month 1931	Stocks at end of January, 1931*
Eastern Pa., N. J., and Md.	**2,033,000**	1,630,000	**1,419,000**	1,123,000	**6,689,000**	6,054,000	5,546,000
New York and Maine	**187,000**	151,000	**257,000**	182,000	1,556,000	**1,957,000**	1,988,000
Ohio, Western Pa., and W. Va.	**762,000**	412,000	**651,000**	415,000	3,401,000	**3,705,000**	3,709,000
Michigan	**543,000**	109,000	**297,000**	220,000	2,761,000	**2,804,000**	2,915,000
Wis., Ill., Ind., and Ky.	**883,000**	427,000	**664,000**	416,000	**4,145,000**	3,966,000	3,955,000
Va., Tenn., Ala., Ga., Fla., and La.	727,000	**836,000**	**881,000**	768,000	1,598,000	**1,833,000**	1,765,000
Eastern Mo., Ia., Minn., and S. Dak.	748,000	**766,000**	**492,000**	377,000	3,396,000	**3,458,000**	3,069,000
W. Mo., Nebr., Kans., Okla., and Ark.	**709,000**	263,000	**764,000**	377,000	1,834,000	**1,952,000**	2,066,000
Texas	**482,000**	286,000	**521,000**	328,000	**778,000**	740,000	782,000
Colo., Mont., Utah, Wyo., and Idaho	130,000	**160,000**	**104,000**	82,000	441,000	**488,000**	410,000
California	**755,000**	709,000	**793,000**	602,000	**1,131,000**	938,000	831,000
Oregon and Washington	**203,000**	171,000	**169,000**	158,000	519,000	**583,000**	570,000
	8,162,000	5,920,000	7,012,000	5,048,000	28,249,000	**28,478,000**	27,606,000

Production, Shipments, and Stocks of Finished Portland Cement, by Months, in 1930 and 1931

	—Production— 1930	—Production— 1931	—Shipments— 1930	—Shipments— 1931	Stocks at end of month 1930	Stocks at end of month 1931
January	**8,498,000**	*6,595,000	**4,955,000**	*4,692,000	27,081,000	***27,606,000**
February	**8,162,000**	5,920,000	**7,012,000**	5,048,000	28,249,000	**28,478,000**
March	11,225,000	....	8,826,000	....	30,648,000	....
April	13,521,000	....	13,340,000	....	30,867,000	....
May	17,249,000	....	17,224,000	....	30,891,000	....
June	17,239,000	....	18,781,000	....	29,364,000	....
July	17,078,000	....	20,153,000	....	26,289,000	....
August	17,821,000	....	20,299,000	....	23,824,000	....
September	16,124,000	....	18,083,000	....	21,889,000	....
October	14,410,000	....	15,599,000	....	20,697,000	....
November	11,098,000	....	8,784,000	....	23,056,000	....
December	8,480,000	....	5,688,000	....	25,883,000	....
	160,905,000	....	158,744,000	....	....	....

Black type indicates larger of two figures.

*Revised.

MEN and MILLS

Notes from the Field

Hunt Is New Penn-Dixie Sales Manager in Iowa Territory

The Pennsylvania-Dixie Cement Corporation, New York City, announces the appointment, effective immediately, of O. C. Hunt as sales manager in charge of the territory served by its Des Moines plant. His headquarters will be in the Insurance Exchange Building, Des Moines, Iowa. R. J. Hild continues as district sales manager.

Prior to his connection with the cement industry more than 16 years ago, Mr. Hunt had wide experience in the building supply business. For more than a year he has managed one of the eastern sales districts of the Penn-Dixie organization.

L. C. Currinder has also joined Penn-Dixie's western staff, with headquarters in the Des Moines office of the corporation.

Arthur Brisbane Talks About New Cement Plant

It is not often that a highly technical subject, such as a cement manufacturing plant, is given attention in popular newspaper features; but Arthur Brisbane, in his syndicated feature "Today," of February 24, presents a well written description of the new cement plant at Hermosillo, Sonora, Mexico.

This plant, recently built for Cemento Portland Nacional, S. A., was described and illustrated in the March issue of the Cement Mill Section of CONCRETE, pages 77-80.

E. P. Bauer in California on Leave of Absence

E. P. Bauer, quarry foreman at the Three Forks Portland Cement Company plant at Trident, Montana, is in California on an eight months' leave of absence. He will return to his duties the latter part of May.

Graham, Universal Atlas Manager, Dies at Indianapolis

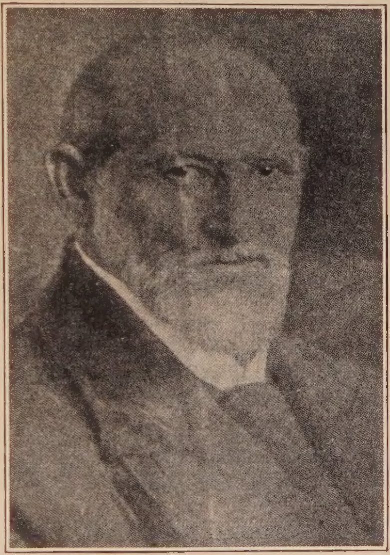
Curtis Milo Graham, district manager for the Universal Atlas Cement Company at Indianapolis, Indiana, for a number of years, died at his home there on February 18th.

Mr. Graham was born 51 years ago in Red Oak, Iowa. He was a member of the Scottish Rite, the Indianapolis Athletic Club, and the Chamber of Commerce.

Friedrich Schott, Leading German Cement Manufacturer, Dies

Dr. Eng. Friedrich Schott, Ph.D., for many years a leader in the German cement industry and one of its outstanding pioneers, died on February 20, at the age of 80, following a fortnight's illness.

His contributions to the knowledge of cement making were numerous and were the fruit of a mentality whose keenness was maintained up to the time of his death.



The late Dr. Friedrich Schott

Dr. Schott's primary commercial interest was the Heidelberg-Mannheim-Stuttgart A. G., in which he held an executive office. He joined the company as manager and chemist in 1875, when it was a small organization known as Schifferdecker & Sons. Under his direction the firm absorbed others, attaining its present position as one of the leading manufactories of the country.

At the time of his death Dr. Schott held office in the Deutscher Zement-Bund G. M. B. H., and was honorary doctor of the Technical High School of Braunschweig and of the University of Heidelberg.

Tubbs Joins Southwestern's Ohio Plant as Chief Engineer

John S. Tubbs has recently joined the Southwestern Portland Cement Company plant at Osborn, Ohio, as chief engineer.

He had until recently been associated for a number of years with the Hawkeye Portland Cement Company plant at Des Moines as assistant chief engineer.

F. B. Hamilton, Former Alpha Plant Chemist, Dies

F. B. Hamilton, formerly chemist at the LaSalle, Illinois, plant of the Alpha Portland Cement Company, passed away on February 20 at his home at La Grange, Illinois. Because of poor health, Mr. Hamilton had retired about a year ago and for the last eight months had made his home in La Grange. His death ended a valiant fight against ill health and his retirement ended many years of service in the portland cement industry.

Launching on his career twenty-five years ago, Mr. Hamilton joined the Coplay, Pennsylvania, plant of the Lehigh Portland Cement Company as an assistant chemist, and later the Mitchell, Indiana, plant of the same company. He left Lehigh to take a position with the German-American Portland Cement Company, La Salle, Illinois, as chief chemist. His long association with this plant was broken by a year spent as chief chemist for the Henry Cowell Lime and Cement Company at Cowell, California. When the German-American plant at La Salle was taken over by the La Salle Cement Company and later by the Alpha company, Mr. Hamilton continued on as plant chemist until his retirement.

Mr. Hamilton was born on February 28, 1867, at Brooklyn, New York.

Office and Laboratory Bowling Team Leads in Superior League

The Office and Laboratory bowling team of the Superior Portland Cement, Incorporated, at Concrete, Washington, was last reported leading the Superior Bowling League, with the Mill team a very close second.

The tournament was to end March 26.

Nebraska Cement Company Safety Committee Active

One of the most active of safety committees is that at the Superior, Nebraska, plant of the Nebraska Cement Company.

Discussion and instructions in safety work are taken up and meetings are held regularly.

Boettcher Adds Hotel to List of Interests

Charles Boettcher, president of the Ideal Cement Company, with his son, Claude K. Boettcher, both of Denver, Colorado, has acquired the Brown Palace Hotel of that city and one of its oldest hostelries.

R. O. Shearer Resigns from Ideal Cement Company

After being connected with the Ideal Cement Company for more than twelve years, Robert O. Shearer resigned recently to become a partner in a general investment house at Denver, Colorado.

Universal Atlas Chorus Sings at Engineers' Reception

The Universal Atlas Cement Company chorus of 70 voices sang several numbers at the reception given by the Western Society of Engineers in the Red Lacquer Room, Palmer House, Chicago, February 25. The meeting was held in honor of Ralph Modjeski, consulting engineer, who received the Washington award for 1931. The Universal Atlas chorus is directed by Harry S. Walsh, and is composed of members of the organization in the Chicago office of the cement company.

Largest Steelhead Brings Cement Worker Reward

Having caught the largest steelhead of the season in the community, George Ely of the Superior Portland Cement, Incorporated, quarry, Concrete, Washington, was recently presented with a fish basket, the gift of a local merchant.

Abrams Talks Before Toledo Architects and Engineers

Dr. D. A. Abrams, director of research of the International Cement Corporation, was the speaker at a meeting of Toledo, Ohio, architects and engineers on March 3. His subject was "Recent Developments in Concrete."

F. T. Brown Talks on Construction Before Kansas Club

The construction industry was the subject of a discussion introduced by F. T. Brown, of the Lehigh Portland Cement Company, before the Current Topics Club of Iola, Kansas, on February 16.

Bankers Visit Ideal Cement Co. Plant at Boettcher

Denver bankers were the guests of the Ideal Cement Company on Lincoln's birthday. The company's newest plant, at Boettcher, Colorado, was inspected.

Mill Equipment

Transportometer a Simple and Accurate System for Weighing Materials

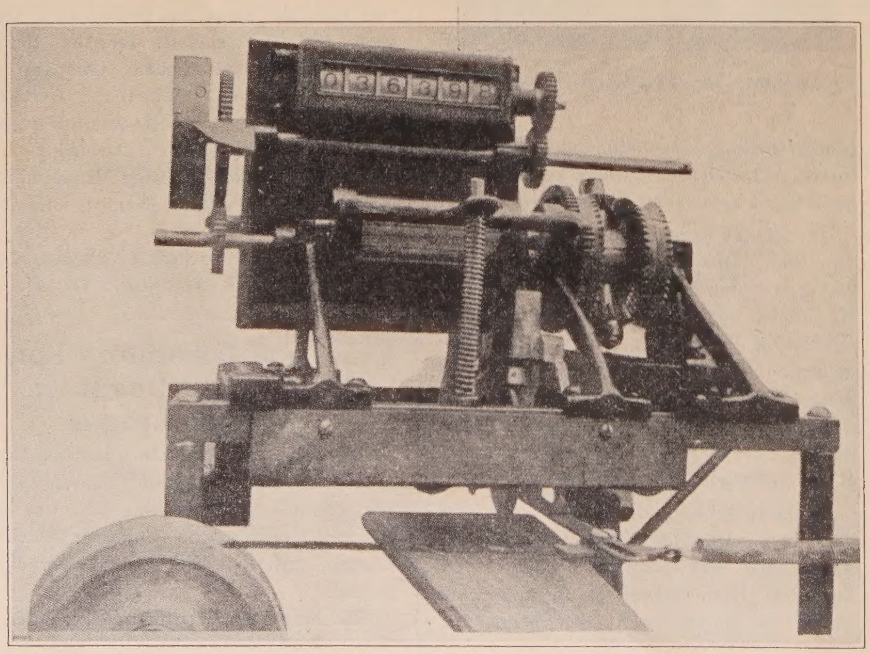
The Transportometer is an efficient system for accurately registering the weight of material in motion on any type of conveyor, according to the Sintering Machinery Corporation, New York City.

Rugged but highly sensitive, it is at the same time mechanically simple and requires only unskilled labor for adjustment and maintenance.

Reasonable cost is insured by standardized design, it is stated, and lever systems on all machines are identical. The unit, furnished with idlers and every necessary detail, is supplied ready to install, complete and self-contained.

Work and cost of installation is reduced to a minimum due to the fact that a suitable support for the rigid frame is the only requirement. Alignment of parts and simplified work of erection is assured by the unit construction.

All integrators are sealed to a single shop standard, and with the exception of gear ratios, are interchangeable.



Improved Link-Belt Grizzly Crawler Loader for 1931

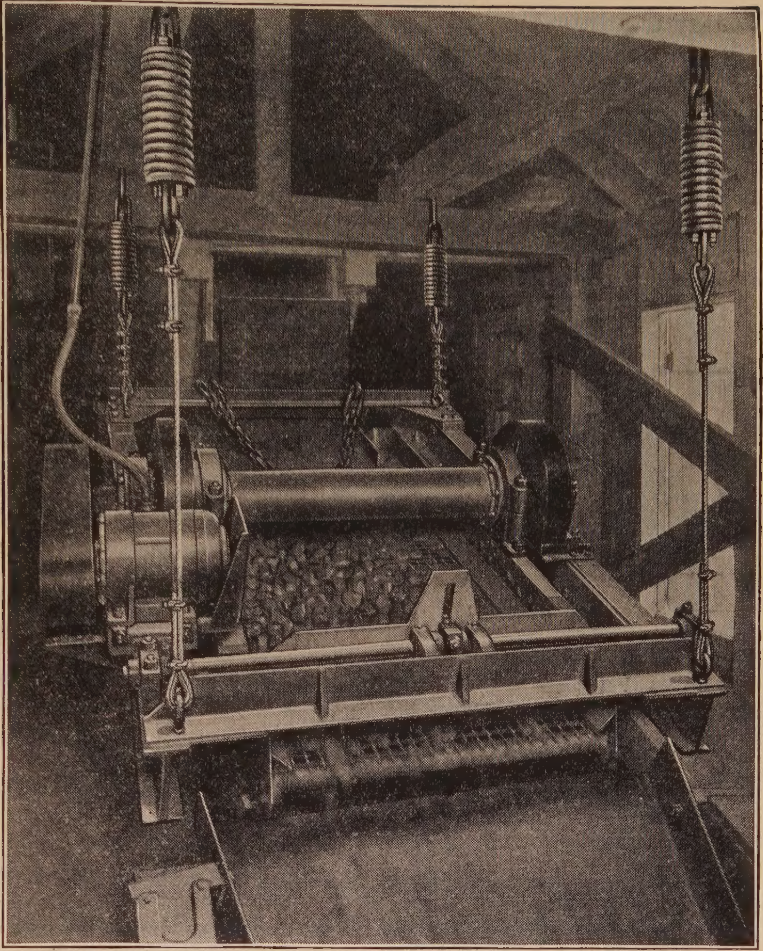
A new Grizzly crawler loader having 1931 improvements has just been announced by the Link-Belt Company, Philadelphia, Pa.

The 1931 Grizzly has the improved helical ribbon type feeder, announced in 1930, with its cast steel spiral which digs, lifts and conveys the material to the buckets, cutting a 7 ft. 7 in. wide swath in the material handled.

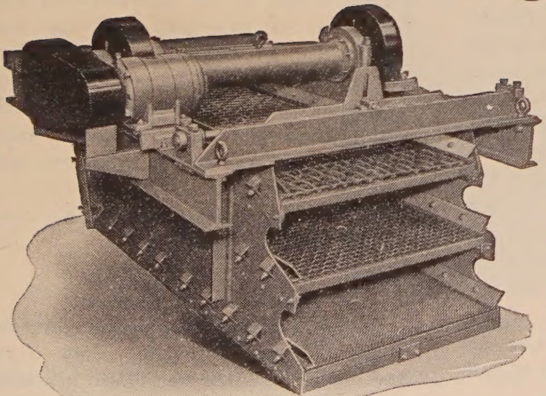
The power plant of the Grizzly is a simple, compact and efficient power unit, consisting of a 30 h.p. Buda gasoline engine, equipped with a governor to regulate the speed automatically; or a 20 h.p. electric motor of standard specifications.

The elevator has a rated capacity of 1¾ cu. yd. per minute, with uniform feed, based on sand, stone and gravel.

A three-speed transmission gives the crawlers a speed of 30 ft. per minute, or 66 ft. per minute, in the digging direction, and 27 ft. per minute in reverse.



Positive Mechanically Produced Motion—equal over entire screen surface



Allis-Chalmers vibrating screens are built with one, two and three decks in sizes 3′ x 6′ and 4′ x 8′ to suit conditions of operation.

. . . . The result, large capacity and a clean product. Allis-Chalmers Vibrating Screens have self-aligning, anti-friction bearings with positive dust seals, alemite lubricated; large eccentric shafts; and all rotating parts fitted with safety guards. The vibrating mechanism can be removed without disturbing the screen body or supporting frame. Screen sections are easily changed and are reversible, end for end. They are also interchangeable. The screening angle is adjustable. Centrifugal Vibrating Screens are built with single, double or triple decks. The liberal clearance between decks facilitates spouting and the changing of screen surfaces. . . . Details of construction and other data on vibrating screens are given in Bulletin 1470-A. May we send you a copy?

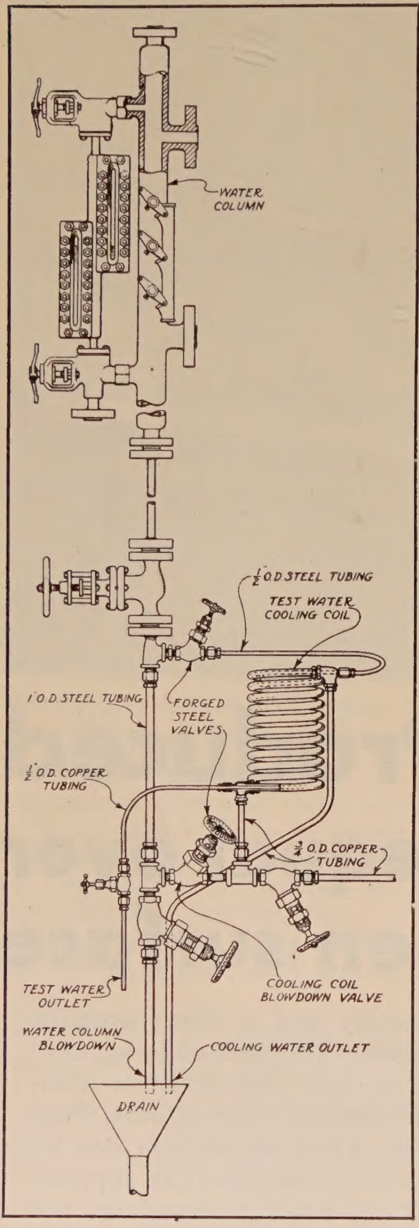
ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee

Water Cooling Coil for Representative Test Samples

A compact and efficient method of securing representative test water samples is now offered by Bailey Meter Company, Cleveland, Ohio, in the Dieform test water cooling coil.

These coils, which consist of a tube within a tube, are made from copper tubing and Dieform compression fittings. In operation the hot test sample enters the smaller inner tube at the top while the cooling water enters the outer tube at the side outlet on the bottom. Cooling water completely surrounds the inner tube as it passes upward through the annular space between the tubes to the side outlet at the top. This type of test water cooling coil performs at maximum efficiency because of the counter flow principle, which tends to equalize the rate of heat transfer throughout the entire length of the coil. It also has an added advantage due to the upward flow of cooling water in that a supply of cooling water always surrounds the inner coil regardless of how slowly water flows through the outer coil.



Dieform test water cooling coils are being used to secure boiler water samples, steam manifold samples, evaporator samples, turbine samples and water samples at boiler feed pumps, feed water storage tanks and purifiers.

The method of installing a Dieform test water cooling coil for obtaining boiler water samples is shown by the line drawing. It will be noted that the inner tube of the coil is connected to the boiler water column blowdown so that samples of test water may be taken from the blowdown line and cooled to room temperature before they are released to atmospheric pressure. Samples taken in this manner may be collected in glass bottles at the test water outlet. A valve in the cooling water supply line makes it possible to vary the flow of cooling water through the coil and thereby control the temperature of the test water sample. The rate of flow of test water is controlled by a forged steel valve in the ½-inch O. D. steel tubing which connects the test water cooling coil to the water column blowdown.

Most successful results are obtained by drawing test water samples at the rate of approximately one quart per minute and by taking a total sample of approximately one gallon.

Dieform test water cooling coils are designed for working pressures up to 1,500 lbs. per square inch and may be built specially for higher pressures if desired.

Industrial Literature

Publication Describes Rock Tunnel Methods

Rock Tunnel Methods is the title of a 92-page publication of exceptional merit recently issued by the *Hercules Powder Company, Inc.*, Wilmington, Delaware. The book is paper covered, 9 by 12 inches in size.

Thirty-one famous tunnels are described, the number including railroad, mine, water supply and hydro-electric tunnels. The data given in each case includes descriptions of the method and equipment employed in drilling, blasting, excavating, transportation, ventilation, and lining.

Numerous maps, cross-sections, dimension tables and blasting diagrams are given, as well as a limited number of halftone illustrations.

Sturtevant Equipment

Sturtevant cement plant equipment employing air separation, known as the *Whirlwind Centrifugal Selector* is described in *Catalog No. 87 B*, issued by the *Sturtevant Mill Company*, Boston, Massachusetts.

Selector installation, phantom, and diagrammatic views are shown and accompanying text is comprehensive.

Worthington Engines and Pump

Publications issued recently by the *Worthington Pump and Machinery Corporation*, Harrison, New Jersey, include the following:

Diesel engines, vertical four-cycle, direct-injection, Type B. Designed for continuous, economical performance covering the 50 to 150 hp. range. *Bulletin S-500-B5*, 8 pages.

Horizontal Duplex Piston Pumps, Type S.P., submerged piston side pot pattern with Wompco or cast-steel liquid ends for 450 and 600 lb., respectively, maximum pressure. *Specification Sheet W-112-S6*, 4 pages.

Horizontal Duplex Piston Pattern Hot Oil Pumps, Type S.P. For hot feed or hot flash service at temperatures up to 700 deg. F. *Specification Sheet W-112-S9*. 4 pages.

Power Pumps, vertical triplex single-acting, forged liquid end pattern, Figure 1845. *Specification Sheet D-423-S9*, 4 pages. Supersedes D-242-A.

Speed Reducer Applications

Helping to solve speed reduction problems is one of the purposes of *"A Survey of Speed Reducer Applications in the Rock Products Industry,"* a 20-page publication issued recently by the *W. A. Jones Foundry & Machine Company*, Chicago, Illinois.

Applications in cement plants are shown in detail photographically. A layout of a modern wet process cement plant shows units adaptable to the use of direct drive with speed reducers and flexible couplings.

Pumping Pulverized Coal

A new catalog, *No. 903*, describing the construction and application of the Fuller-Kinyon system to the transportation and distribution of pulverized coal, has just been issued by the *Fuller Lehigh Co.*, New York, N. Y. Besides including a general description and a diagrammatic sketch of the system, the catalog contains a number of illustrations of the equipment and views of installations.

Copies of the catalog are available upon request to the company.

Waste Heat Boiler

Bulletin WB-30-2, published by the *Foster Wheeler Corporation*, New York, New York, describes and illustrates what is claimed to be the first extended waste heat surface boiler.

Illustrations depict a number of installations.

G-E Induction Motors

Squirrel-cage induction motors, Type KG, are cataloged in a 4-page looseleaf of the standard size published by the *General Electric Company*, Schenectady, New York.